WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO / IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)

SHIP OBSERVATIONS TEAM

FIFTH SESSION

GENEVA, SWITZERLAND, 18-22 MAY 2009

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ITEM I-2.1

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REPORT BY THE SECRETARIAT

(Submitted by the Secretariat)

Summary and purpose of the document

This document provides information on actions taken since the fourth session of the SOT, and on decisions and priorities by both WMO and IOC executive bodies and emerging topics that SOT should be aware related to activities under the JCOMM Observations Programme Area (OPA), the Data Management Programme Area (DMPA), and the Services Programme Area (SPA).

ACTION PROPOSED

The Team will review the information contained in this report, and comment and make decisions or recommendations as appropriate. See part A for the details of recommended actions.

Appendices: A. WMO Strategic Plan for 2008-2011 and Beyond, Top-level objectives, Strategic thrusts, and Expected results for the 15th financial period
B. JCOMM OPA Operating Plan
C. JCOMM Statement of Guidance for Ocean Applications
D. Outcome of the seventh Session of the JCOMM Management Committee

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

I-2.1.1 The Secretariat reported briefly on activities under or associated with JCOMM which have taken place since SOT-IV (April 2007), and are of direct interest to the Team. The Team noted that several meetings had taken place during the intersessional period, involving JCOMM Panels and Programmes, as well as other relevant bodies.

I-2.1.2 The Team noted, in particular that following the recommendations from the JCOMM Management Committee, the Observations Coordination Group at its third Session (Paris, 9-11 March 2009) adopted an operating plan for the Observations Programme Area, which was aligned with the two organizations' Expected Results (Appendix B). The Team agreed to cooperate to the execution of the plan. The Management Committee agreed that JCOMM needed to develop a catalogue of JCOMM Standards and Best Practices. A consultant has been recruited to undertake the work, which should be completed, and the catalogue published on the web, prior to JCOMM-III (Morocco, 4-11 November 2009). The Team agreed to contribute to this work, as appropriate.

I-2.1.3 The Team noted the development of a plan to define a standards accreditation as well as a standards development process for ocean data management under JCOMM and IODE. It recognized that the standards process was regarded as a contribution to the ODP-WIGOS Pilot Project for IODE and JCOMM. These issues are being discussed under agenda item I-5.3.

I-2.1.4 The Team noted the development within the JCOMM Data Management Programme Area of an "Oceanographer's and Marine Meteorologist's Cookbook for Submitting Data in Real Time and In Delayed Mode". The Cookbook provides instructions for many kinds of data. Completion of this manual will require assistance from the OPA. The "cookbook" is providing information on procedures required to provide data for exchange in real-time, who to contact for assistance and other practical matters. Similar information will be available for delayed mode data. It is planned to present the first version of the Cookbook to JCOMM-III. The Team invited the Technical Co-ordinator to participate in this exercise from a ship-based observations perspective.

I-2.1.5 The Team noted the cooperation between the ETMC and the ETWS for the development of a database of extreme wave events. In addition, ETMC, ETWS, and ETSI have coordinated efforts in the development of marine climate indices in collaboration with the joint CLIVAR / CCl / JCOMM Expert Team on Climate Detection and Indices (ETCCDI). VOS Operators are invited to contribute to the database as appropriate.

I-2.1.6 Team Members are invited to contribute to feeding the JCOMM extreme wave database events when such events are observed by data buoys and are recorded by Team Members (***Action: Team Members, ongoing***). The information should be submitted to the RNODC / DB who will forward it to the appropriate database.

The Meeting decided on the following action items:

I-2.1.7 To provide input to the DMCG chairperson for the Oceanographer's and Marine Meteorologist's Cookbook for Submitting Data in Real Time and In Delayed Mode (***Action: Technical Co-ordinator, ASAP***).

- B - BACKGROUND INFORMATION

1. Governing bodies

1.1. World Meteorological Organization (WMO)

1.1.1 The Fifteenth WMO Congress (Cg-XV), Geneva, Switzerland, (7-25 May 2007). The preamble of the WMO Convention was amended, with effect from 1 June 2007, to reflect and make clear how the scope and responsibilities of the Organization have evolved since it was established in 1950. The WMO Strategic Plan for 2008-2011 and beyond was approved, including three top-level objectives, five strategic thrusts and the eleven Organization-wide expected results for the 15th financial period (Appendix A*)*. In particular, the following Expected Results have been approved: the integration of WMO observing systems (ER-4), the development and implementation of the WMO Information System (WIS) (ER-5), and enhanced capabilities of Members in multi-hazard early warning and disaster prevention and preparedness (ER-6). Congress revised the terms of reference of the Commission for Atmospheric Science and the Commission for Climatology.

1.1.2 Cg-XV drew Members attention to the risk of disruption in essential observational datasets and urged them to make efforts aimed at ensuring continuity of measurements. and timely transfer of research-based systems into operational status. The Congress welcomed Morocco's offer to host the third session of the JCOMM. Congress urged the WMO Secretary-General, the IOC Executive Secretary and the co-presidents of JCOMM to further strengthen the integration of WMO and IOC activities, in order to provide a more effective and cost-efficient JCOMM work plan. This includes enhancing coordination of JCOMM with the Intergovernmental Coordination Groups of the different tsunami warning and mitigation systems in order to sustain the systems initiated through the IOC as an integral component of a comprehensive multi-purpose global ocean observing system.

1.1.3 Cg-XV commended JCOMM on its pro-active role in assuming responsibility for the ocean components of the Global Climate Observing System. It urged Members concerned to collaborate actively in the implementation of the MMOP and the work of JCOMM by supporting the implementation of regional demonstration projects promoted by WMO and IOC, in areas such as preparedness for marine coastal hazards as part of integrated coastal area management, particularly, in the case of extreme events (e.g. storm surges, and high and/or long waves) and analysis of the impacts of oceanic response to climate variability and change. Congress requested the Secretary-General to work with Members and space agencies to ensure better continuity and overlap of relevant space-based and *in situ* ocean observing systems and to move experimental observing systems into operational status.

1.1.4 The Fifty-ninth WMO Executive Council (EC-LIX), Geneva, Switzerland, (28- 30 May 2007). The Council acknowledged the proposals made by the JCOMM Ship Observations Team (SOT) on ship call sign masking and encoding, and stressed the importance of developing a general and universally acceptable solution to this issue that would address ship owners and masters' concerns, as well as, the operational, data monitoring and quality information feedback, and climate requirements. The Council adopted Resolution 7.7/1 (EC-LIX) that recommends continuing the trial masking schemes in successive years, unless decided otherwise by the Executive Council, while pending the universal acceptance and implementation of a more suitable solution and the CBS migration to table driven codes. The Natural Disaster Prevention and Mitigation Programme was renamed to Disaster Risk Reduction Programme (DRR).

1.1.5 EC-LX, Geneva, Switzerland, 17- 27 June 2008. The Council highlighted the important opportunity for enhancing WMO's role in the UN-coordinated response to climate change as a lead agency in the area of weather, climate and water, the creation and improvement of knowledge on climate system variability and change, as well as preparations for the forthcoming World Climate Conference-3 (WCC-3) in 2009.

1.1.6 EC-LX approved a Concept of Operations and Implementation Plan for the new WMO Integrated Global Observing Systems (WIGOS), a comprehensive, coordinated and sustained system of observing systems. One component of WIGOS's many observing systems is the expansion of weather measurements on commercial aircraft, aiding in the forecasts vital for commercial aviation. The Council was encouraged with the major steps taken towards the implementation of the first operational Global Information System Centre (GISC) by early 2009, as well as of several international pilot projects, and it urged WMO Members to focus special efforts and resources on the further implementation of other operational WIS international centres in 2009–2011. It fully supported the work of WMO technical commissions in developing and finalizing the technical and operational procedures, based on international standards for ensuring interoperability.

1.1.7 The Council re-emphasized that the WMO Information System (WIS) will be a core WMO contribution and an interoperable information system within the Global Earth Observing System of Systems (GEOSS) as regards weather, climate and water data.

2. Intergovernmental Oceanographic Commission of UNESCO (IOC)

2.1 The 39th session of the IOC Executive Council (EC-39), (21-28 June 2006) adopted a Medium-Term Strategy for 2008-2013 based on four High-Level Objectives:

i.) Prevention and reduction of the impacts of natural hazards,
ii.) Mitigation of the impacts of and adaptation to climate change and variability,.
iii.) Safeguarding the health of ocean ecosystems, and
iv.) Management procedures and policies leading to the sustainability of coastal and ocean environment and resources. Implementation of the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS) and the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS), for which the technical coordination takes place in large part through the coordination of national efforts via the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), supports primarily the second of IOC's High Level Objectives.

2.2 The 25th session of the IOC Assembly (ASS-25), (19-28 June 2007) and the 41st session of the IOC Executive Council (EC-41), (24 June–1 July 2008) noted the continuing support for the role and priorities of JCOMM.

3. Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM)

3.1 The following JCOMM-related meetings or meetings where JCOMM has been represented have taken place during the period:

JCOMM meetings:

(i.) Second Session of the JCOMM Observations Coordination Group (OCG)[1], Geneva, Switzerland, 23-25 April 2007. The SOT Chairperson attended the meeting and represented the Team. Major topic of discussion at the meeting was the development of an Observing Programme Support Centre (agenda item I-5.1); A User Requirement Document in support of Marine Services was presented to the Group.

(ii.) Tenth session of the GLOSS Group of Experts (GE)[2], Paris, France, (4-8 June 2007). Thirty-three national reports, and three regional reports were provided at this meeting. Of the 290 stations in the GLOSS Core Network (GCN), 217 (75%) have provided data recently to one of the GLOSS Data Centres, which represents the participation of 69 nations. It was decided that the GE will expand its activities to include technical advice and strategic planning for water level stations intended for hazards monitoring. GLOSS GE will also explore funding opportunities to upgrade 50 GCN stations to include continuous GPS for land motion corrections. An update of the GLOSS Implementation Plan is under development and the first draft is expected to be completed by the end of 2007. More information about GLOSS is available at www.gloss-sealevel.org.

1 : ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-43-DMCG-2/J-MR-43-DMCG-2.pdf
2: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/J-MR-58-GLOSS-GE-X.pdf

(iii.) DBCP/IODE/ODINAFRICA Training Course on Buoy Programme Implementation and Data Management, Ostend, Belgium[1], (11-15 June 2007).

(iv.) JCOMM Scientific and Technical Symposium on Storm Surges[2], Seoul, Republic of Korea, (2-6 October 2007).

(v.) Twenty-third Session of the Data Buoy Cooperation Panel (DBCP)[3], Jeju, Republic of Korea, (15-19 October 2007). The Panel agreed with its operating principles and proposed to establish Task Teams to deal with: (a) data management, (b) quality management, (c) technological developments, (d) capacity building, and (e) moored buoys. The Panel updated its implementation strategy. The new version included recent modifications to global requirements for buoy data in support of WMO and IOC Programmes. The review encompassed implementation aspects such as the deployment strategy, and the number of barometer drifters to be deployed worldwide, including in the tropical regions, and in the Southern Ocean (now 300 units), as well as development of appropriate technology to meet the expressed requirements. The DBCP drifter Iridium Pilot Project has formally started in July 2007 for a two-year period. The DBCP now plans to apply the Panel's experience and resources in the development of training materials for Capacity Building in developing nations on a sustained basis.

(vi.) Tenth International Workshop on Wave Hindcasting and Forecasting & Coastal Hazard Assessment[4], North Shore, Oahu, Hawaii, USA, (11-16 November 2007);

(vii.) Sixth Session of the JCOMM Management Committee[5] (MAN-6) Paris, France, (3-6 December 2007). Regarding the strategic planning of WMO and IOC, the Committee agreed that JCOMM should review and align the current JCOMM work programme with the two organizations' Expected Results. Noting the rapid development of operational ocean forecasting systems and the need for information on and coordination of these systems, the Co-presidents of JCOMM, with the endorsement of the Committee, established an Expert Team on Operational Ocean Forecast Systems (ET-OOFS) in the Services Programme Area. JCOMM-II had requested a review of JCOMMOPS. MAN-6 agreed that the OPSC process provided an adequate review of JCOMMOPS as requested by JCOMM-II. A third version of the web tool Observing System Monitoring Centre (OSMC) is available on the web[6] and includes some performance monitoring of variables. The Committee agreed that use of this tool is to be widely encouraged. The Committee agreed that there was a need to develop a catalogue of JCOMM Standards and Best Practices, and recommended to engage a consultant for a month to undertake the work, which should be completed, and the catalogue published to the web, prior to JCOMM-III.

(viii.) The First Session of the IODE / JCOMM Forum on Oceanographic data Management and Exchange Standards, Ostend, Belgium, (21-25 January 2008). Twenty participants representing a wide spectrum of expertise in the ocean data management community attended the meeting. The goals for the meeting were to: (i) try to reach an international agreement for standards that are suitable as initial versions; (ii) identify the "best practices" that are not mature enough for acceptance yet; and (iii) define a process by which future standards could be developed, reviewed, and adopted or existing ones changed. A limited number of standards were agreed upon (e.g., time, lat. / lon.). These will then have to go through the proper channels before being accepted as such. The Meeting agreed on a plan for defining a standards accreditation and a standards development process for ocean data

1: http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=80
2: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-44/index.htm
3: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-54-DBCP-23-Final.pdf
4: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-44/index.htm
5: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/J-MR-55-MAN6.pdf
6: http://www.osmc.noaa.gov/

management under JCOMM and IODE. Additional details are available on the dedicated web site[1].

(ix.) XBT Fall-Rate Equation Workshop[2], Miami, Florida, United States of America, (10-12 March 2008). Analyses of concurrent XBT, CTD and Argo float observations indicate that there is a systematic difference in temperature profiles, which is likely due to an error in the XBT fall-rate equation. This error has introduced a warm bias in the global XBT database. This issue was discussed at the workshop, and recommendations were made. The requirements for real-time distribution of XBT metadata as a contribution to the META-T Pilot Project were also discussed. See agenda item IV-3.2.

(x.) Third Session of the JCOMM Data Management Coordination Group[3] (DMCG-3), Ostend, Belgium, (26-28 March 2008). The Group noted the significant progress towards developing ocean data standards, table driven codes (TDCs), and the rapid progress with the JCOMM Pilot Project for the WMO Integrated Global Observing Systems (WIGOS). The Expert Team on Marine Climatology (ETMC) reported on the reorganization of work with the creation of two task teams, the TT-MOCS (Marine-meteorological and Oceanographic Climatological Summaries) and the JCOMM crosscutting TT-DMVOS (Delayed-Mode VOS data). ETMC will develop a database of extreme wave events in collaboration with the Expert Team on wind Waves and Storm Surges (ETWS) and extend the contents of the International Comprehensive Ocean-Atmosphere Data Set (I-COADS). They will address quality control process for surface meteorology and oceanographic measurements, and continue to guide the development of the metadata pilot project for water temperature measurements (METAT). ETMC and ETWS are collaborating with the Expert Team on Sea Ice (ETSI), and the joint CLIVAR / CCl / JCOMM Expert Team on Climate Detection and Indices (ETCCDI) to develop marine climate indices. The metadata project will expand its view to include other instrumentation and variables. Similarly, for ETMC, the ETDMP created a task team to continue the development of the E2E technology, which will focus activities on supporting the WIGOS work. The main work of ETDMP will be re-focused on standards development through managing the standards process, and will continue until JCOMM-III as a pilot project. The JCOMM Observations Programme Area (OPA) will help to write a document, which explains how marine data can be distributed in both real-time and delayed-mode. This will contribute to a catalogue of best practices being assembled by the JCOMM Management Committee.

(xi.) *Ad hoc* planning meeting for the WIGOS Pilot Project for JCOMM[4], Ostend, Belgium, (29 March 2008). The meeting addressed the instrument best practices issues, recognized the need for traceability to agreed standards, and recommended establishing cooperation with the WMO Commission on Instruments and Methods of Observation (CIMO); build on its experience with regard to instrument inter-comparisons, instrument centres, etc. The various related publications available via WMO and IOC will be reviewed and updated as required. The meeting proposed to explore the establishment of one or more marine and oceanographic instrument centre(s) and reviewed the methodology proposed by CIMO for conducting instrument intercomparisons to ensure homogeneity, and compatibility of the observations. The meeting reviewed its project plan and proposed some changes. It particularly identified partners willing to pursue participation in the Pilot Project by providing data sets to the ODP and WIS, as well as potential partners. Because of the strong potential synergies between the ODP and the JCOMM Pilot Project for WIGOS, the meeting proposed to establish a joint Steering Group with balanced representation from the IOC and WMO communities. See agenda item I-5.3.

(xii.) Meeting of the OPSC pre-evaluation Committee, Paris, France, (11 April 2008). The meeting

1: http://www.oceandatastandards.org/
2: http://www.aoml.noaa.gov/phod/goos/meetings/2008/XBT/index.php
3: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-56-DMCG-3-final.pdf
4: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-57-WIGOS1.pdf

for the pre-evaluation of the Letters of Intent (LOI) for a future WMO-IOC Observing Programme Support Centre (OPSC) reviewed the 15 letters of intent and proposed a short list of six centres. The Evaluation Committee proposed to expand itself to include the JCOMM Co-presidents, representatives of the Observing Panels under JCOMM, as well as WIGOS and OOPC representatives. A final recommendation was expected to be provided by the end of 2008 to the Executive Secretary of IOC and Secretary-General of WMO for their final joint decision. See also agenda item I-5.1 for details.

(xiii.) Third international workshop on advances in Marine Climatology[1] (CLIMAR-III), Gdynia, Poland, (6-9 May 2008). The workshop showed emerging synergies with the satellite community (e.g., through GHRSST and WIGOS) and the need for integrated products including a bias corrected ICOADS. The need for sustained ocean observations was stressed (VOS, Argo, satellite observations) but the Meeting stressed that the use of VOS data was threatened because of the decline of the VOS fleet and ship masking. The manual VOS observations are important because of the long history of such data. New technologies are emerging (e.g., AUV, autonomous ships and gliders) and sufficient overlap must be provided with the current technologies. The CLIMAR community should be working through WIS and WIGOS to ensure that the data sets that are produced are highly visible. A team is forming to draft the white paper proposal for the extension of the International Comprehensive Ocean-Atmosphere Data-Set (ICOADS) to handle bias corrections and perhaps other components such as in situ and satellite climatologies and products (e.g., GHRSST). The Meeting discussed the characteristics required from marine indices and proposed a list of possible indices as well as a list of doable ones.

(xiv.) Meeting of the JCOMM crosscutting Task Team on Delayed-Mode VOS data (TT-DMVOS), and the ETMC Task Team on Marine-Meteorological and Oceanographic Climatological Summaries[2] (TT-MOCS), Gdynia, Poland, (10 May 2008). The Meeting agreed that the production of climatological summaries as part of the Marine Climatology Summaries Scheme (MCSS) did not meet the requirements of current users and a plan was initiated for its modernization. The Meeting agreed to develop a stronger connection to the WIGOS and to seek the participation of the GCCs in the JCOMM Pilot Project for WIGOS.

(xv.) OGP / JCOMM / WCRP Workshop on Climate Change and the Offshore Industry[3], Geneva, Switzerland, (27-29 May 2008). Approximately 80 participants from the science community and from the offshore industry attended the meeting. The objectives of the workshop were to:

(1) gather evidence on climate change, its emerging impacts on offshore activities and review the evolving industry requirements for Met-ocean services in a changing climate
(2) identify and prioritize key areas for future research and development towards the adaptation of the offshore industry and its MetOcean services to climate change; and
(3) strengthen coordination of existing and future research and development initiatives for better protection of the marine environment and increased safety and efficiency of offshore operations.

A number of initiatives were discussed for future collaboration between JCOMM and OGP, including data sharing, improving standards for data collection and quality control as well as met-ocean services to address the industry requirements.

(xvi.) Informal workshop of the Water Temperature Metadata Pilot Project[4] (META-T), Geneva, Switzerland, (16-17 September 2008). The Meeting in particular, reviewed the requirements for real-time distribution of category 1 metadata for VOS, Argo, buoys, and XBTs, as well as

1: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-45-CLIMAR-III/index.html
2: http://www.jcomm.info/index.php?option=com_oe&task=viewEventRecord&eventID=344
3: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-42-OGP_JCOMM_WCRP_workshop/index.htm
4: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/J-MR-60-META-T2.pdf

the requirements for developing the metadata servers (category 2 metadata). See agenda item IV-3.2 for details on metadata and META-T.

(xvii.) Meeting of the joint Steering group for the Ocean Data Portal and the WIGOS Pilot Project for JCOMM[1], Geneva, Switzerland, (18-19 September 2008). The Meeting agreed that interoperability with the WIS would be mainly achieved through: (i) ocean data centres contributing to the ODP and (ii) ODP becoming fully interoperable with the WIS. It recommended that the JCOMM Observing Panels and associated programmes address the issue of documenting their instrument best practices in light of the WIGOS developments. It discussed the establishment of marine instrument centres using CIMO as a model. The NOAA National Data Buoy Centre (NDBC) offered to investigate feasibility and to start this on a trial basis. The Meeting reviewed potential partners and data contributions. It noted that discussions had taken place since the March 2008 meeting to address some of them, namely the SeaDataNET, the GHRSST-PP, and the Global Collecting Centres (GCCS). It noted with appreciation the development of a virtual constellation for the measurement of Ocean Surface Vector Wind. Thirteen potential partners were identified for providing key data sets to the Pilot Projects as key deliverables. The Meeting updated its Project Plan, reviewed the draft Implementation Plan, adopted them, and proposed a strategy for reviewing progress considering risks, and trade-offs between time to deliver the project, costs and available resource, and quality of the deliverables. See agenda item I-5.3.

(xviii.) Joint DBCP-ETWS Wave Observation Technology Workshop from Buoys[2], New York, United States of America, (2-3 October 2008).

(xix.) Twenty-fourth session of the Data Buoy Cooperation Panel[3], Cape Town, Republic of South Africa, (13-16 October 2008). The format and agenda for the session was significantly re-organized and streamlined compared to previous years. The Panel substantially updated its operating principles and implementation strategy and approved them. In particular, the Panel formally adopted its Task Teams on: (i) Data Management (TT-DM); (ii) Instrument Best Practices and Drifter Technology Developments (TT-IBPD); (iii) Capacity-Building (TT-CB); and (iv) Moored Buoys (TT-MB). The Panel agreed to make efforts to better integrate its instrument Best Practices in the WIGOS context. It further recommended that the buoy manufacturers establish links with the HMEI. It engaged in building stronger synergies with the OceanSITES, and agreed that its Technical Co-ordinator could work 30% of the time for OceanSITES. It noted that the initial Iridium Pilot Project target for deploying 50 Iridium drifters had been achieved, but that the geographical distribution was not appropriate at this point. The Panel agreed to continue to upgrade scheme in 2009 and plan for an additional 40 units, on the understanding that 2010 would be dedicated to an analysis effort. The Panel agreed to establish three new Pilot Projects for (i) the evaluation of Argos-3 technology, (ii) Wave Measurement from Drifters (PP-WMD), and (iii) Wave measurement Evaluation and Test from moored buoys (PP-WET). The Panel agreed to support organization of a Capacity-Building Workshop for East and South Africa to be held during the summer of 2009.

(xx.) Seventh Session of the JCOMM Management Committee[4], Melbourne, Australia, (8-12 December 2008). The committee discussed the preparation of JCOMM-III (Marrakech, Morocco, 4-11 November 2009). It decided to establish three task teams to address priority areas within both WMO and IOC on (1) Quality Management Framework; (2) Coastal Inundation; and (3) Methods for Transmission of Graphical Products to Marine Users. It endorsed the proposed alignment of the JCOMM Operating Plan with the WMO and IOC Strategic Planning in terms of deliverables and/or achievements planned for presentation to JCOMM-III. The Committee reviewed the draft table of OPA deliverables/achievements as well

1: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-59-ODP-WIGOS2.pdf
2: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-TR/J-TR-47-WaveObs/index.html
3: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/J-MR-61-DBCP-XXIV.pdf
4: ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/J-MR-61-DBCP-XXIV.pdf

as the OPA work plan, and recommended future reporting of ECV-based (Essential Climate Variables) metrics and indices for satellite and in situ data and metadata. The Committee noted the evaluation process for the WMO-IOC Observing Programme Support Centre (OPSC). The Committee agreed on a time table for producing a document named "Observing the Global Ocean for JCOMM - The Integrated Space-based and *in situ* Strategy" and covering the current use of space and *in situ* observations in existing products and services, including tables of current requirements by variable. The Committee agreed that "Data and Information Exchange Cookbook" for oceanographers and marine meteorologists would be a valuable contribution to upgrading the documentation of best practices. The Committee agreed on developing a statement of principles for JCOMM Capacity Building (CB) – to replace of an overall JCOMM CB strategy – describing the implementation mechanism, and activities to be undertaken by JCOMM in this area, including training, transfer of technology, and development of projects. The Committee reviewed JCOMM subsidiary structure and, in the light of its achievements, agreed on a broad structure to be proposed at JCOMM-III. Details on MAN-VII outcome can be found in Appendix D.

(xxi.) Third Session of the JCOMM Observations Coordination Group, Paris, (9-11 March 2009). The Group reaffirmed that its priority remains on building and sustaining the current systems (including those coordinated under the SOT) to agreed standards with near-real-time data reporting, and broadening the base of national participation. The Group recommended that the SOT maintain contact with the SCOR group on volunteer ship ocean observatories to avoid overlap and duplication, and to align messages to both ship operators and the scientific communities. It asked the SOT to discuss management of Publication 47 in order to make a recommendation to JCOMM-III. It asked the SOOP to consider implementation of a stricter real-time QC for profile data. The Group reviewed the OPA implementation goals (previously known as the OPA strategic workplan), and proposed a strategy for updating the document taking into account latest developments with regard to the GCOS implementation plan and foreseen recommendations, as well as non-climate requirements arising from the CBS Rolling Review of Requirements and resulting Statements of Guidance and gap analysis. It emphasized the importance of a dialogue between implementers and potential users asking for new capabilities based on their requirements, in order to find ways forward that balance technological capability, network optimization, and funding interest. The Group discussed the JCOMM OPA metrics, and noted in particular that non-GTS data, including XBT data in the Coriolis database, should be included in metrics. The OPSC evaluation committee presented the current status of the evaluation and the Group made further recommendations in this regard in particular regarding negotiations that should be undertaken with the candidates in order to bring further benefits to the future OPSC. The Group reviewed the list of Community White Papers (CWP) that will be presented to the OceanObs'09 symposium (Venice, 21-25 September 2009).

Appendices: 4

APPENDIX A

**WMO STRATEGIC PLAN FOR 2008-2011 AND BEYOND,
TOP-LEVEL OBJECTIVES, STRATEGIC THRUSTS, AND EXPECTED RESULTS FOR THE 15TH FINANCIAL PERIOD**

Top-level objectives

- more accurate/timely/reliable forecasts and warnings
- improve the delivery of information and services to the public, governments and other users
- provide scientific and technical expertise and advice in support of policy and decision-making and implementation of the agreed international development goals and multilateral agreements.

Strategic thrusts

- Science and technology development and implementation to monitor and observe the environment, to forecast and warn of significant weather, water and climate conditions, and to understand the Earth system
- Service delivery to ensure that society can realize the full benefit of the weather, water and climate information and services that WMO Members produce
- Capacity-building to sustain and improve the ability of all Members, with a particular focus on developing and Least Developed Countries to provide essential environmental services to their societies;
- Partnership to work with international agencies, other organizations, academia, the media and the private sector to improve the range and quality of critical environmental information and services;
- Efficient management and good governance to ensure environmental information and services are affordable.

Expected results

1. Enhanced capabilities of Members to produce better weather forecasts and warnings
2. Enhanced capabilities of Members to provide better climate predictions and assessments
3. Enhanced capabilities of Members to provide better hydrological forecasts and assessments
4. Integration of WMO observing systems
5. Development and implementation of the WMO Information System
6. Enhanced capabilities of Members in multi-hazard early warning and disaster prevention and preparedness
7. Enhanced capabilities of Members to provide and use weather, climate, water and environmental applications and services
8. Broader use of weather, climate and water outputs for decision-making and implementation by Members and partner organizations
9. Enhanced capabilities of Members in developing countries, particularly least developed countries, to fulfil their mandates
10. Effective and efficient functioning of constituent bodies
11. Effective and efficient management performance and oversight of the Organization

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APPENDIX B

DRAFT JCOMM OBSERVATIONS PROGRAMME AREA (OPA) OPERATING PLAN

1. Introduction

1.1 At its Seventh Session, Melbourne, Australia, 8-12 December 2008, the JCOMM Management Committee reviewed proposals for aligning the JCOMM Operating Plan with the WMO and IOC Strategic Planning in terms of the high-level deliverables and/or achievements planned for presentation to JCOMM-III, as well as work priorities proposed for the next intersessional period. This was reviewed again at the third Session of the Observations Coordination Group (OCG), Paris, France, 9-11 March 2009. This will constitute JCOMM's response to the requirements of WMO and IOC for reporting the implementation plans of their major subsidiary bodies against the Expected Results under the respective Organizational strategies. This exercise effectively results in prioritizing JCOMM OPA work plan for the next few months until JCOMM-III and for the next JCOMM intersessional period. Once reviewed, updated, and agreed, by JCOMM, paragraph 2 below together with Annexes 1, 2, and 3 will constitute the JCOMM OPA Operating Plan.

2. Deliverables and/or Achievements planned for presentation to JCOMM-III, and Programme Area work plan for the remaining intersessional period, and the next JCOMM intersessional period.

2.1 The deliverables and/or achievements planned for presentation to JCOMM-III, the Programme Area work plan for the remaining intersessional period, and the Programme Area work plan for the next intersessional period which are detailed below are also summarized in tabular form in Appendices A, B, and C respectively.

Deliverable 1: JCOMM Observing System Implementation Goals

2.2 It is required to update the JCOMM Observing System Implementation Goals (previously named OPA Strategic workplan) to take into account latest developments in terms of requirements for climate applications (e.g. the GCOS Implementation Plan is now being revised), but also requirements arising from the WMO Rolling Review of Requirements (RRR) and detailed in the Statements of Guidance for a number of application areas. The RRR applications areas the most relevant to JCOMM are (i) Seasonal to inter-annual forecasting, (ii) Ocean Applications (i.e. Met-Ocean Forecasts and Services (MOFS), including marine services, marine hazards warning, and ocean mesoscale forecasting), (iii) Global Numerical Weather Prediction (NWP), (iv) Regional NWP, and (v) Synoptic Meteorology.

2.3 The JCOMM Observing System Implementation Goals also needs to be updated (i) to take into account effective developments of the observing system since JCOMM-II (September 2005), (ii) to refine the implementation targets for the different components of the observing networks, and (iii) to better consider integration of both in situ and satellite observations. In addition, there will be a need to address the recommendations from the OceanOBS09 conference (e.g. how to design the XBT network in face of the completed Argo and TIP).

2.4 Recent developments with regard to the WMO Integrated Global Observing Systems (WIGOS) also need to be considered.

2.5 By OCG-III, 58% of the ocean observing system will be completed. A moderate increase of national support for in situ observations should permit to achieve 60% completion by JCOMM-III, i.e. a 10% increase compared to what was presented at JCOMM-II. Achievements to be reported at JCOMM-III in terms of observing system implementation include the following elements:

- While the drifter array achieved its target at JCOMM-II, it remained sustained since them at its 1250 units level, and 50% of the drifters are now equipped with barometer;
- Argo and VOSClim achieved their observing targets although efforts remain to be made

to achieve better geographical coverage of Argo, and to record the additional VOSClim elements;

- TAO/TRITON and PIRATA are being maintained at target;
- Progress with regard to RAMA in the Indian Ocean;
- Progress with regard to OceanSITES;
- Significant increase in real-time reporting sea level stations with GPS.

2.6 Based on the updated JCOMM Observing System Implementation Goals, it is proposed that JCOMM-III adopts a recommendation urging Members/Member States to commit resources towards achieving the implementation targets and sustaining the networks.

2.7 For the next intersessional period, it is proposed that JCOMM would work at achieving Completion and sustainability of the observing system by JCOMM-IV, i.e. essentially:

- Updating the JCOMM Observing System Implementation Goals taking into account the revised GCOS implementation plan, recommendations from the OceanOBS'09 conference, and non climate requirements arising from WMO and IOC application areas;
- Sustaining Argo and other observing components that reached completion;
- Providing the required additional elements (i.e. QC flags, metadata) for all of the VOSClim ships;
- Completion of the RAMA network in the Indian Ocean;
- Completion of the network of ocean reference stations (OceanSITES);
- Completion of the Sea level network, including real-time reporting and installation of GPS receivers for geo-referencing;
- Completion of the Repeat Hydrography and carbon inventory;
- Equipping all newly deployed drifters with Barometers;

Deliverable 2: Observing Programme support Centre (OPSC)

2.8 Following JCOMM-II recommendation, a comprehensive review of JCOMMOPS was conducted in close consultation with relevant ocean observing Panels and groups. It was recognized that in order to fully implement a sustained global ocean observing system, the JCOMM in situ Observing Platform Support Centre (JCOMMOPS) will have to evolve into an expanded technical support centre to serve the growing requirements of the DBCP, SOT, and AST, and in addition begin to serve the developing requirements of other international programmes, which are also working to coordinate elements of the global ocean observing system. This expansion is expected to greatly enhance the implementation of GOOS by servicing all global observing components/elements with a system-wide approach. System-wide coordination, cooperation, and efficiencies will be improved by all systems working together to manage global implementation issues. This should include system performance monitoring, system evaluation, coordination of deployment opportunities, consolidated reporting, technical advice, and technical coordination to improve system efficiency and effectiveness.

2.9 The JCOMMOPS review process lead to issuing a joint WMO-IOC letter calling Members/Member States to propose to host a future Observing Programme Centre (OPSC). The OPSC will essentially consist of the expanded JCOMMOPS as detailed above. The call resulted in fifteen letters of intent being received, and an evaluation committee lead by the JCOMM Co-Presidents was formed to review the proposals. Final decision regarding who should be selected to host the future OPSC is expected to be made by the Secretary General of WMO, and the Executive Secretary of IOC before OCG-III (March 2009).

2.10 JCOMM-III will be invited to formally establish the OPSC, which will be replacing the existing JCOMMOPS. OPSC will be established by mean of a JCOMM Recommendation defining inter alia its Terms of Reference (to be drafted and proposed by OCG-III), hosting agency, staff, and management conditions. Members/Member States will be invited to contribute financially or in kind to the new OPSC.

Deliverable 3: WIGOS Pilot Project for JCOMM

2.11 Following decisions and recommendations by the WMO fifteenth Congress (Resolution 30 - Cg-XV), the WMO Integrated Global Observing Systems (WIGOS) was initiated and Pilot Projects proposed. One of the Pilot Project for JCOMM was initiated in 2008 in close cooperation with the International Oceanographic Data and Information Exchange (IODE) of IOC. The Pilot Project has defined is project plan and implementation plan, and substantial progress will be reported to JCOMM-III.

2.12 One aim of the Pilot Project will be to define and agree on common standards for instruments and methods of observation as well as subsequent organization and handling of the data and information to deliver consistent and better quality data to both the broad user and modelling communities. Data records must be traceable to standards. Maintenance and calibration are critical for ensuring stability and sustainability of systems. To understand system and component performance, a thorough documentation of observing platform siting and history as well as the recording and updating of metadata are critical in the elimination of in-homogeneities in data records. Closer links have been established with the WMO Commission for Instruments and Methods of Observation (CIMO). The Pilot Project will address the issue of documenting instrument best practices (DBCP, SOT, GLOSS, IOCCP, OceanSITES, Argo) in light of the WIGOS developments, and to provide input to the WMO Guide for Instruments and Methods of Observations (WMO No. 8 – CIMO Guide) and other relevant documentation comprised in the JCOMM Catalogue of Best Practices and standards. The Pilot Project will be a mechanism for providing input to the JCOMM Catalogue of Best Practices and Standards. In addition, the Pilot Project is promoting establishment of Regional Marine Instrument Centres on a trial basis. Such centres will facilitate having all WIGOS observational data and metadata and processed observational products to adhere to WIGOS standards for instruments and methods of observation as well as standard observing network practices and procedures. They will be essential for monitoring instrument performance, calibration procedures, providing assistance with regard to intercomparisons, as well as providing for appropriate training facilities that would complement what the manufacturers are currently providing. Invited ocean experts will be in a position to provide required training.

2.13 Another aim will be to make appropriate identified data sets interoperable with the wider WMO and IOC communities in order to facilitate international data exchange - using agreed upon data and metadata representation forms and formats - and ensures that ocean data sets are properly searchable through modern data exchange systems that meet ISO requirements for geographical information. The Pilot Project, for which interoperability with the WMO Information System (WIS) and/or the IODE Ocean Data Portal (ODP) should be developed, has identified thirteen potential data sets. These data sets include both situ (e.g. Argo, drifters, GTSPP, marine climatology) and satellite observations (e.g. GHRSST, SVW). Agencies in charge of those data sets have been approached and some of them are already committed to the Pilot Project. The ODP will become interoperable with the WIS as a Data Collection and Production Centre (DCPC).

2.14 JCOMM-III will be invited to endorse the Pilot Project and Implementation Plans, approve changes to CIMO Guide as proposed by the Pilot Project, and approve establishment of Regional Marine Instrument Centres, including their Terms of Reference.

2.15 While the WIGOS Pilot Project for JCOMM should end by the end of 2010, two of its last deliverable will be (i) a business plan for the integration of marine observations in WIGOS, and (ii) a legacy plan for pursuing the integration of the ocean observing systems, including in situ and satellite systems.

2.16 Based on the recommendations from the WIGOS Pilot Project for JCOMM, for the next intersessional period, JCOMM will work at better integrating satellite observations, including virtual constellations such as GHRSST, ocean topography, and surface vector wind. Closer links will be established within JCOMM with Argo, OceanSITES, and IOCCP. Work will continue to document instrument best practices in appropriate WMO & IOC Manuals and Guides, including the WMO Guide on Instruments and Methods of Observation (WMO No. 8), and the JCOMM Catalogue of Best Practices and standards. Assessment of marine instrument centres as established or recommended by JCOMM-III will have to be made, and new centres proposed as appropriate. JCOMM will also continue to work at providing additional data sets through the WIS (e.g. Sea level, GHRSST, SVW, Ocean Colour, Sea Ice, Waves).

Deliverable 4: New wave observing technology

2.17 Requirements for wave observations include (i) assimilation into wave forecast models; (ii) validation of wave forecast models; (iii) calibration / validation of satellite wave sensors; (iv) ocean wave climate and its variability on seasonal to decadal time scales; and, (v) role of waves in coupling. Marine forecasters use wave model outputs as guidance to issue forecasts and warnings of important wave variables (such as, significant wave height and dominant wave direction) for their area of responsibility and interest, in support of several marine operations. In situ observations are used for the validation of models and satellite products with requirements of 1000km spacing requiring a network of around 400 buoys with minimum 10% / 25cm accuracy for wave height and 1 second for wave period.

2.18 A JCOMM Technical Workshop on Wave Measurements from Buoys was held in New York City, New York, United States of America, from 2 to 3 October 2008. The workshop was organized jointly with the DBCP and the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS). A key outcome of the workshop was the proposal – endorsed by the DBCP at its twenty-fourth Session, Cape Town, October 2008 - to establish a Pilot Project on Wave Measurements from Drifters (PP WMD) within the DBCP framework to look at feasibility to develop new cost-effective technology (e.g. using GPS). A twin project was also established, the JCOMM Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET).

2.19 JCOMM-III will be invited to approve the development of both PP-WMD and PP-WET, and Members/Member States will be invited to commit resources in support of the Pilot Projects.

2.20 Until JCOMM-III, OPA will follow the recommendations from the wave workshop and DBCP-24, as well as the development of PP-WMD, and PP-WET. Work will continue after JCOMM-III with completion of both Pilot Projects before JCOMM-IV.

2.21 Depending on the success and recommendations of the Pilot Project, and to address the requirements for wave model and satellite wave products validation,the OPA in due course may recommend the implementation of a global in situ wave observing system. This will include installation of wave observing technology on JCOMM operational moorings (OceanSITES and Tropical Moorings), and sustaining no more than 300 drifters capable of making cost-effective wave observations.

Deliverable 5: Satellite data telecommunication

2.22 There is a strong demand from the ocean data community for cost-effective, global satellite coverage, real-time high data-rate telecommunication, sufficient system capacity, and two-way telecommunication with the in situ ocean observing platforms. There is for example an increasing demand for high temporal resolution data with frequencies usually higher than one observation per hour and much higher in case of some applications (e.g. Tsunami monitoring). Two-way communication also permits new approaches to data acquisition, management and distribution with the potential to make the best use of on-board systems depending upon local or regional geo-physical conditions, while saving battery power and extending the platform lifetime.

2.23 Many governmental and commercial satellite systems are being used for the full range of ocean platforms, each of them having their strengths and weaknesses and addressing most of the criteria above. Progress has been made recently regarding the evaluation of new satellite data telecommunication systems such as Iridium, which have considerable potential for the broadband collection of meteorological and oceanographic data from ocean platforms, as well as for two-way communication with those platforms.

2.24 Excellent progress with regard to the DBCP iridium Pilot Project will be reported at JCOMM-III, as the initial target of 50 units to be deployed in the world oceans has been exceeded, and the data now distributed on GTS from CLS and Météo France. However, efforts remain to be made to test the technology in all ocean conditions and regions and make sure, that the data can be distributed on the GTS after appropriate QC procedures have been applies, and the data encoded according to the standard GTS formats.

2.25 JCOMM-III will be invited to support the continuation of the evaluation of current satellite data telecommunication systems, as well as the DBCP & SOT Iridium Pilot Projects in order to permit the collection of high data-rate data, and two-way telecommunication with the observing platforms. It will also be invited to encourage Members/Member States to use Iridium. The DBCP will be invited to work at the design of an effective global solution for the GTS distribution of data collected via Iridium according to agreed quality control procedures and data formats. DBCP will be invited to negotiate cost-effective GTS data processing with the satellite data telecommunication and GTS data processing service providers. The DBCP and SOT Pilot Projects should be completed during the next intersessional period and results presented to JCOMM-IV so that further recommendations can be made to Members/Member states by then.

Deliverable 6: JCOMM Metrics

2.26 Progress was made since JCOMM-II regarding the development of integrated performance metrics to routinely report observing system monitoring and performance for certain key ocean variables. This was made possible thanks to cooperation with the GOOS Project Office, ISDM, Canada, various US agencies through the new Observing System Monitoring Center (OSMC), and JCOMMOPS.

2.27 Work will continue so that at JCOMM-III it will be reported that metrics will be routinely produced on a quarterly basis for Sea Surface Temperature, Sea Surface Salinity, sub-surface Temperature, sub-surface Salinity, surface Currents, and Heat storage of the mixed layer. The metrics are being made available via the OSMC and the new OPSC.

2.28 At its seventh Session, the JCOMM Management Committee recommended future reporting of ECV-based (Essential Climate Variables) metrics and indices for satellite and in situ data and metadata. JCOMM-III will be invited to urge OPA to complete the metrics scheme accordingly, and to invite Members/Member States to use the Metrics.

Deliverable 7: Integration of satellite observations

2.29 Much progress has been made in recent years for addressing the ocean community requirements for satellite data. For example, satellite altimetry is permitting ocean mesoscale forecasting; scatterometers address the requirements for tropical and extra-tropical high-wind warnings for mariners; GHRSST products (Sea Surface Temperature) enable better ocean/NWP forecasts and flux products for ocean research; and imagery permits the monitoring of sea-ice extend.

2.30 The crosscutting Team on Satellite Data Requirements has initiated work for the production of a document titled “Observing the Global Ocean for JCOMM - The Integrated Space-based and in situ Strategy.” It aims to articulate a singular set of observing requirements for JCOMM for key ocean variables that space the applications from near-real time marine operations, NWP, climate monitoring, and research. Its scope will include Sea Surface Temperature, Sea Surface Salinity, Sea Surface Height (including sea state), Surface Vector Winds (including wind stress), Ocean Colour (chlorophyll-a), Sea Ice (Extent). The document will cover the current use of space and in situ observations in existing products and services (derived from known sources), including tables of current requirements by variable. It will highlight similarity and differences in operational and research requirements. The key content would be the JCOMM Strategy – a unified set of requirements for each variable, and consequences for an idealized observing system, where such requirements are fully realized.

2.31 The document will be presented to JCOMM-III after consultation with JCOMM and CBS experts. The Commission will be invited to endorse the document and urge Members/Member states to commit resources towards achieving the implementation targets and sustaining the missions, and develop a strategy for approaching the satellite agencies with this guidance via established channels at the WMO and IOC.

2.32 Plans until JCOMM-III and for the next JCOMM intersessional period are to enhance liaison with satellite experts in both WMO and IOC through the appropriate bodies and Expert Teams (e.g. CBS ET-SAT and ET-SUP, CEOS, CGMS). The new OPSC would be requested by JCOMM-III to coordinate the collection of information on satellite data requirements and the information on satellite planning. Efforts will continue towards the developments of the Virtual constellation for Surface Vector Wind, global wave observing capability, and sustainability of satellite missions including GHRSST and ocean topography.

2.33 JCOMM will work towards better integration of in situ and satellite observations, as well as the consideration of new variables such as sea ice, wind, wave and storm surge observations. JCOMM will focus on the coordination of ocean variables where a viable integrating participation group is available.

Deliverable 8: Capacity Building

2.34 Partnerships for New GEOSS Applications (PANGEA) are designed to build sustainable capacity in maritime regions by conducting in country, practical, socio-economic applications training by JCOMM experts to decision-makers, policy and budget administrators, scientists and end-users, in exchange for regional ship time for the deployment of new in-situ ocean observations.

2.35 PANGEA provides multiple benefits by (i) providing expert applications training to users and decision-makers in the region; (ii) demonstrating the practical socio-economic importance of ocean information to administrative budget and policy officials; and (iii) increasing regional in-situ ocean observations for numerous crosscutting applications that impact the region.

2.36 The PANGEA Partnerships provide socio-economic benefits for various economic sectors including fisheries, agriculture, climate and coastal risk management, water resource management, community resiliency and marine multi-hazards. A more sustainable capacity for the region can be achieved through the increases in both near real-time in-situ ocean observational data and information as well as the more effective applications of existing and new data.

2.37 JCOMM-III will be invited to plan/organize PANGEA workshop during the next JCOMM intersessional period using multiple sources of funding (WMO&IOC, National, DBCP TF, etc.).

ANNEX 1

DELIVERABLES AND/OR ACHIEVEMENTS PLANNED FOR PRESENTATION TO JCOMM-III

Observations Programme Area					
Deliverables and/or Achievements	**Summary of the Activity(ies)**	**Decisions/Actions (if any)**	**Recommendations (if any)**	**Formal Recommendation or Resolution required for JCOMM-III (Y/N; and subject)**	**Contribute to Expected Result(s) (WMO/IOC)**
JCOMM Observing System Implementation Goals	Updated JCOMM Observing System Implementation Goals presented to the Session. The plan, still based on the guidance in GCOS-92, was updated according to latest developments, including consideration of WIGOS, current status of the observing system, integration of in situ and satellite observations, and new requirements (Statements of Guidance from WMO Rolling Review of Requirements)	Endorse workplan	Urge Members/Member States to commit resources towards achieving the implementation targets and sustaining the networks and satellite missions	Y; Implementation of the JCOMM Observing System Implementation Goals	WMO ER 4 IOC HLO 1, 2
Grew and maintained a system 10% closer to OPA targets for the in situ Observing System	• Observing System 60% completed through moderately increasing annual national support for in situ observations. • Drifter array achieved target at JCOMM-II and remained sustained close to target; 50% of the drifters now equipped with barometer • Argo and VOSClim achieved observing target (incl. additional elements), TAO/TRITON and PIRATA maintained at target. • Progress with regard to RAMA in the Indian Ocean • Progress with regard to OceanSITES • Significant increase in real-time reporting sea level stations with GPS	No	No	N	WMO ER 4 IOC HLO 1,2
OPSC	New OPSC in place	Endorse new OPSC and decisions	Members/Member States to contribute to the new OPSC	Y; TOR of OPSC	WMO ER 4 IOC HLO 2
WIGOS PP for JCOMM	• Substantial progress with regard to the Implementation plan • Document best practices and provide input to the CIMO Guide	Endorse Project Plan and Implementation Plan Approve changes to CIMO Guide	Members/Member States invited to apply for running Regional Marine Instrument Centres	Y: TOR of Regional Marine Instrument Centres	WMO ER 4, 5 IOC HLO 2

Observations Programme Area

Deliverables and/or Achievements	Summary of the Activity(ies)	Decisions/Actions (if any)	Recommendations (if any)	Formal Recommendation or Resolution required for JCOMM-III (Y/N; and subject)	Contribute to Expected Result(s) (WMO/IOC)
	• Contribution to the JCOMM Catalogue of Best Practices and Standards • Regional Marine Instrument Centres on a trial basis and proposed TOR	Approve establishment of Regional Marine Instrument Centres			
Plans for new wave observing technology	• Recommendations from the JCOMM Technical Workshop on Wave Measurements from Buoys (NY, USA, 2-3 Oct 2008) and DBCP-24 • Pilot Project on Wave Measurement from Drifters (PP-WMD), and JCOMM Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET) initiated	Approve development of PP-WET	Members/Member States to commit resources in support of the Pilot Project	N	WMO ER 4 IOC HLO 1,2
Enhanced Satellite data telecommunication	• Excellent progress with regard to the Iridium Pilot Project • More Iridium drifters deployed than planned (target was 50) but tests need to be conducted in all ocean conditions • GTS data processing for Iridium Data working at Météo France and CLS (with standard QC and formats)		Encourage Members/Member States to use Iridium Invites DBCP to negotiate cost-effective GTS data processing by CLS	N	WMO ER 4, 5 IOC HLO 2
Integrated (space and in situ) observing strategy document	Document presented to the session	Endorse document	Urge Members to commit resources towards achieving the implementation targets and sustaining the missions, and develop a strategy for approaching the satellite agencies with this guidance via established channels at the WMO and IOC	N	WMO ER 4 IOC HLO 1, 2
JCOMM Metrics	• Metrics being routinely produced on a quarterly basis for 6 variables (SST, SSS, Tz, Sz, surface currents, heat storage of mixed layer) and made available via OSMC and OPSC	Endorse metrics	Urge NOAA and ISDM to complete the metrics for other variables Invites Members/Member States to use the Metrics	N	WMO ER 4 IOC HLO 2

ANNEX 2

PROGRAMME AREA OPERATING PLAN FOR THE REMAINING INTERSESSIONAL PERIOD

Observations Programme Area						
Deliverables	**Summary of the Activity(ies)**	**By whom (Group/Team)**	**Key Performance Target(s) and Indicator(s)**	**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
JCOMM Observing System Implementation Goals	OCG-III meeting (Mar 2009) to update JCOMM Observing System Implementation Goals according to: • latest developments, including consideration of WIGOS and integration of *in situ* and satellite observations • new requirements for marine forecast and services (JCOMM Statement of Guidance) • addressing XBT measurements in face of completed Argo and TIP	OCG	KPT: Updated workplan KPI: 0 (fail) or 1 (success)	Likelihood: High Severity: Medium	WMO ER 4 IOC HLO 2	WIGOS CBS (ICT-IOS, ET-EGOS, ET-SUP, ET-SAT) OOPC GOOS
Implementation of the JCOMM Observing System Implementation Goals	• SOT-V meeting (May 2009) • DBCP-25 + S&T workshop, and JTA-29 meetings (Oct. 2009) • One DBCP CB workshop in East Africa (mid-2009) • GLOSS-GE-XI meeting (May 2009) • Sustain DBCP, Argo, TAO, and PIRATA • Further Develop RAMA • Sustain VosClim (250 ships) and provide the required additional elements • Add barometers on all newly deployed drifters • More real-time sea level stations • Through coordination with the scientific programmes, increase OceanSITES time series stations and complete IOCCP decadal survey	OPA & Obs. Panels	KPT: Completion of the observing system KPI: Percentage of completion	Likelihood: Medium Severity: High	WMO ER 4 IOC HLO 1,2	WIGOS CBS (ICT-IOS, ET-EGOS, ET-Sat, ET-SUP) IOCCP GOOS

Observations Programme Area						
Deliverables	**Summary of the Activity(ies)**	**By whom (Group/Team)**	**Key Performance Target(s) and Indicator(s)**	**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
	• For satellite issues, coordination undertaken by email mainly for (i) assisting in the development of the Virtual constellation of Surface Vector Wind (SVW) (ii) contributing to the development of global wave observing capability (in liaison with ET-SAT, ET-SUP), (iii) contributing to the continued development and sustainability of GHRSST, and (iv) sustainability of missions (sea level in particular).					
OPSC	• Evaluation of questionnaires by evaluation committee (by email) • Recommendations by evaluation committee • Decision by WMO and IOC • Terms of Reference proposed by OCG-III, including management structure for staff • Contractual arrangements for staff • Transition from JCOMMOPS to OPSC	Evaluation Committee WMO&IOC Secr.	KPT: OPSC in place KPI: Number of steps achieved (0 to 5)	Likelihood: Medium Severity: Medium	WMO ER 4 IOC HLO 2	WIGOS CBS (ICT-IOS)
WIGOS PP for JCOMM	One meeting of the joint Steering Group (late 2009) Implementation of the plan, i.e. mainly • Providing data sets through GTS and WIS and/or ODP (e.g. GHRSST, ocean topography, SVW) • To address the issue of documenting instrument best practices (DBCP, SOT, GLOSS, IOCCP, OceanSITES, Argo) in light of the WIGOS developments, and to provide input to the CIMO Guide and other relevant WMO % IOC Manuals and Guides, as well as documentation comprised in the JCOMM Catalogue of Best Practices and standards • Implement Regional Marine Instrument Centres on a trial basis and propose TOR	OPD-WIGOS & Obs Panels	KPT: Integrated best practices documented in WMO No. 8, and instrument centres in each of the 6 Regional Associations KPI: WMO No. 8 updated : success=1; fail=0; plus ratio of instrument centres established (n/6)	Likelihood: Medium Severity: Low	WMO ER 4, 5 IOC HLO 2	WIGOS, WIS CBS (ICT-IOS, IPET-MI, ET-AWS) CIMO (IMOP) IODE
Plans for new wave observing	• Coordination by email mainly plus discussion at	DBCP, ETWS	KPT: Pilot Projects	Likelihood: High	WMO ER 4	WIGOS

Observations Programme Area						
Deliverables	**Summary of the Activity(ies)**	**By whom (Group/Team)**	**Key Performance Target(s) and Indicator(s)**	**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
technology	JCOMM meetings as appropriate • Follow recommendations from DBCP-24 and development of Pilot Project on Wave Measurement from Drifters (PP-WMD) • Establish JCOMM Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET), and follow up		Established and Initiated KPI: 0 (fail), 1 (success)	Severity: Low	IOC HLO 1	CBS (ICT-IOS, ET-EGOS)
Enhanced satellite data telecommunication	• Continue review of Satellite data Telecommunication Systems under DBCP leadership • Coordination by email and DBCP/TC mainly plus discussions at SOT-V & DBCP-25 • Complete DBCP & SOT Iridium Pilot Projects and make recommendations • Deploy more Iridium drifters and use Iridium on more ships • Distribute Iridium ocean observing platform data of required quality on GTS in real-time	DBCP, SOT	KPT: 50 drifters evaluated KPI: percentage of drifters compared to target (n/50)	Likelihood: High Severity: Medium	WMO ER 4, 5 IOC HLO 2	WIGOS, WIS CBS (ICT-IOS, ET-DRC)
Integrated (space and in situ) observing strategy document	• Eric Lindstrom to draft document • Document to be reviewed by JCOMM & CBS experts • Final draft approved by JCOMM Co-Presidents	OPA	KPT: Document available KPI: 0 (fail) or 1 (success)	Likelihood: High Severity: High	WMO ER4, IOC HLO 2	WIGOS CBS (ICT-IOS, ET-EGOS, ET-SUP, ET-SAT) GOOS, GCOS, OOPC
JCOMM Metrics	• Discussions at OCG-III plus coordination by email • Resume routine production of metrics for the 6 variables (SST, SSS, Tz, Sz, surface currents, heat storage of mixed layer) • Produce ECV-based metrics and indices for satellite and in situ data and metadata	OCG	KPT: Metrics routinely available for 9 variables KPI: percentage of variables addressed routinely	Likelihood: Medium Severity: High	WMO ER 4 IOC HLO 2	WIGOS CBS (ICT-IOS, ET-EGOS) OOPC IODE

ANNEX 3

PROGRAMME AREA OPERATING PLAN FOR THE NEXT INTERSESSIONAL PERIOD

Observations Programme Area											
Deliverables	**Priority (low, medium, high)**	**Summary of the Activity(ies)**	**By whom (Group/Team) (Suggest changes on the PA structure if required)**	**Key Performance Target(s) and Indicator(s)**	**Timelines**				**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
					2010	**2011**	**2012**	**2013**			
Completion and sustainability of the observing system	High	• Updating the JCOMM Observing System Implementation Goals taking into account new GCOS implementation plan, recommendations from OceanOBS'09, and WMO Rolling Review of Requirements • Yearly DBCP & JTA meetings • Biennial SOT meetings in 2011, 2013 • Biennial GLOSS-GE meetings in 2011, 2013 • CB workshops as required/appropriate • Coordination through JCOMMOPS, then OPSC • Provide additional elements for the VOSClim • Complete RAMA • Complete OceanSITES • Complete Sea level network, including real-time reporting and GPS • Complete Repeat Hydrography • All drifters with Barometers • Sustainability of Argo and completed networks • For satellite observations, coordination	OPA & Obs. Panels	KPT: Completion of the observing system KPI: Percentage of completion	x	x	x	X	Likelihood: Medium Severity: High	WMO ER 4 IOC HLO 1,2	WIGOS CBS (ICT-IOS, ET-EGOS, ET-SUP, ET-SAT) GOOS GCOS OOPC

Observations Programme Area											
Deliverables	**Priority (low, medium, high)**	**Summary of the Activity(ies)**	**By whom (Group/Team) (Suggest changes on the PA structure if required)**	**Key Performance Target(s) and Indicator(s)**	**Timelines**				**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
					2010	**2011**	**2012**	**2013**			
		by email mainly and participation of JCOMM experts at ET-SAT, ET-SUP, CEOS, CGMS as appropriate for (i) coordination on requirements and provision of information on satellite planning through JCOMMOPS, then OPSC, (ii) contribution to the development of the Virtual constellation for Surface Vector Wind (in liaison with ET-SAT, ET-SUP), (iii) contribution to the development of global wave observing capability (in liaison with ET-SAT, ET-SUP), (iv) contribution to the continued development and sustainability of GHRSST, and (v) sustainability of missions (sea level in particular)									
Integration in WIGOS	High	• One meeting of the joint Steering Group in 2010 • Coordination by email • Integration of Argo, OceanSITES, IOCCP in JCOMM • Integration of *in situ* and satellite observations • Provide data sets through WIS and/or ODP (e.g. Sea level, GHRSST, SVW, Ocean Color, Sea Ice, Waves) • Integration of Best Practices (to feed in WMO No. 8, JCOMM Catalogue, and other appropriate IOC Manuals & Guides) • Run existing, establish new Regional Marine Instrument Centres; assess	OPD-WIGOS & Obs Panels	KPT: Integrated best practices documented in WMO No. 8, and instrument centres in each of the 6 Regional Associations KPI: WMO No. 8 updated : success=1; fail=0; plus ratio of instrument centres established	x	X			Likelihood: High Severity: High	WMO ER 4, 5 IOC HLO 2	WIGOS, WIS CBS (ICT-IOS, IPET-MI, ET-AWS, ET-Sat, ET-SUP) CIMO (IMOP) Argo, OceanSITES, IOCCP

Observations Programme Area											
Deliverables	**Priority (low, medium, high)**	**Summary of the Activity(ies)**	**By whom (Group/Team) (Suggest changes on the PA structure if required)**	**Key Performance Target(s) and Indicator(s)**	**Timelines**				**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
					2010	**2011**	**2012**	**2013**			
		effectiveness of established centres • Complete the Business plan for the WIGOS PP for JCOMM, and agree on a legacy plan		(n/6)							
Global wave observing system	Medium	• Coordination at JCOMM meetings as appropriate • Workshop as required/appropriate • Complete DBCP Pilot Project on Wave Measurement from Drifters (PP-WMD) • Complete JCOMM Pilot Project on Wave measurement Evaluation and Test from moored buoys (PP-WET) • Implement global wave observing system according to the outcome of the Pilot Project	DBCP, ETWS	KPT: New cost-effective technology available KPI: 0 (fail), 1 (success)	x	X			Likelihood: Medium Severity: Medium	WMO ER 4 IOC HLO 1,2	WIGOS CBS (ICT-IOS, ET-EGOS)
Enhanced satellite data telecommunica tion	High	• Continue review of Satellite data Telecommunication Systems under DBCP leadership • DBCP and SOT Iridium Pilot Projects; coordination at DBCP and SOT meetings, through JCOMMOPS/OPSC, and by email • Deploy more drifters, VOS, ASAP, SOO, etc. with Iridium • Distribute quality platform data collected via Iridium on GTS in real-time	OPA & Obs. Panels	KPT: Observing platforms meeting requirements for high temporal resolution data KPI: Percentage of deployed platforms meeting the requirements	X	x	x	x	Likelihood: High Severity: Medium	WMO ER 4, 5 IOC HLO 2	
JCOMM Metrics	Medium	• Produce ECV-based metrics, and indices for satellite and in situ data and	OPA	KPI: 0 (fail), 1 (success)	X	X	X	X	Likelihood: Medium Severity: Low	WMO ER 4, 5 IOC HLO 2	WMO CBS

Observations Programme Area												
Deliverables	**Priority (low, medium, high)**	**Summary of the Activity(ies)**	**By whom (Group/Team) (Suggest changes on the PA structure if required)**	**Key Performance Target(s) and Indicator(s)**	**Timelines**				**Risks (likelihood of occurrence (low, medium, high) and severity of the consequences from occurrence (low, medium high)**	**Contribute to Expected Result(s) (WMO/IOC)**	**Links with other Programmes in WMO and IOC**
					2010	**2011**	**2012**	**2013**			
		metadata									
PANGEA	Medium	• Plan/organize PANGEA workshop using multiple sources of funding (WMO&IOC, National, DBCP TF, etc.) • Partnership for New GEOSS Applications (PANGEA) • Inviting developed countries to contribute to PANGEA and provide (i) funds, (ii) expertise to assist developing countries receiving support regarding the use of the data • Developing Countries to support the implementation of ocean observing networks by providing logistical capabilities. • WMO to commit resources for PANGEA through CB efforts, and assist in organizing PANGEA workshops	OPA & SPA	KPT: Organize one workshop per year KPI: Number of workshops organized	x	x	x	X	Likelihood: Low Severity: High	WMO ER 4, 9	WMO TCOP, RP IOC CD

APPENDIX C

STATEMENT OF GUIDANCE FOR OCEAN APPLICATIONS

(*Updated January 2009*)

This Statement of Guidance (SOG) was developed through a process of consultation, to document the observational data requirements in support of ocean applications. This version was based originally on the JCOMM Users Requirement Document, prepared by the Chairpersons of the Expert Teams under the JCOMM Services Programme Area. It is expected that the Statement will be reviewed at appropriate intervals by the JCOMM Services Programme Area Coordination Group to ensure that it remains consistent with the current state of the relevant science and technology.

1. Introduction

Marine Meteorology and Oceanography have a global role and embraces a wide range of users from international shipping, fishing and other met-ocean activities on the high seas to the various activities, which take place in coastal and offshore areas, and on the coast itself. In preparation of analyses, synopses, forecasts and warnings, knowledge is required of the present state of the atmosphere and ocean. Three major met-ocean application areas critically depend on highly accurate observations of met-ocean parameters:

(i) Numerical Weather Prediction (NWP);
(ii) Seasonal to Inter-annual Forecast (SIA); and,
(iii) Met-Ocean Forecasts and Services (MOFS), including marine services and ocean mesoscale forecasting.

The key met-ocean variables to be observed and forecasted in support of NWP and SIA are addressed in the Numerical Weather Prediction and the Seasonal to Inter-annual Forecast Statements of Guidance (SoG). Met-ocean Services, which refer to special elements, such waves, storm surges, sea-ice, ocean currents, etc., critically depend on relevant observational data. This Statement of Guidance provides a brief discussion of the key met-ocean observational requirements for Met-Ocean Services, concentrating on those parameters not covered by previous sections of this document. In particular, variables, such precipitation, air temperature, humidity and cloud cover, required for marine services are addressed in the global and regional NWP SoG.

The requirements for met-ocean forecasts and services stipulated here are based on a consensus of the met-ocean modelling and forecasting communities. It builds on the requirements for global and regional wave modelling and forecasting, marine meteorological services, including sea-ice, and ocean mesoscale forecasting, and represents in addition those variables that are known to be important for initialising, testing and validating models and assimilation, as well as for providing services.

2. Data Requirements

The following terminology has been adhered to as much as possible: poor (minimum user requirements are not being met), marginal (minimum user requirements are being met), acceptable (greater than minimum but less than optimum requirements are being met), and good (near optimum requirements are being met).

2.1 Wind-Wave parameters (significant wave height, dominant wave direction, wave period, 1D frequency spectral wave energy density, and 2-D frequency-direction spectral wave energy density)

Global and regional wave models are used to produce short and medium-range wave forecasts (typically up to 7 days) of the sea state, with a horizontal resolution of typically 30 -100 km for global models, and down to 3-4 km for regional models (with a natural progression to higher resolution expected). Marine forecasters use wave model outputs as guidance to issue forecasts and warnings of important wave variables (such as, significant wave height and dominant wave direction) for their area of responsibility and interest, in support of several marine operations. Specific users usually require additional parameters that are obtained from the directional spectrum of wave energy density.

The observational requirements for global and regional wave modelling are depended on the applications for which the data are required and based on the need to provide an accurate analysis of the sea state at regular intervals (typically every 6 hours). These include:

(i) assimilation into wave forecast models
(ii) validation of wave forecast models
(iii) calibration / validation of satellite wave sensors
(iv) ocean wave climate and its variability on seasonal to decadal time scales; and
(v) role of waves in coupling

Additionally, wave observations are also required for nowcasting (0 to 2 hours) and issuing / cancelling warnings, and very-short-range forecasting (up to 12 hours) of extreme waves associated with extra-tropical and tropical storms, and freak waves (in this case, in combination with other variables such as ocean currents). Whilst nowcasting is largely based on observational data, very-short range forecasting is being generated based on high-resolution regional wave models.

The key model variables for which observations are needed are:

(i) significant wave height;
(ii) dominant wave direction;
(iii) wave period;
(iv) 1-D frequency spectral wave energy density; and
(v) 2-D frequency-direction spectral wave energy density.

The collocated surface wind observations, advantageous for validation activities, are also important. Additional parameters are of value for use in delayed mode validation (e.g. full time series of sea surface elevation).

The geographical coverage of the *in situ* wave data is still very limited and most measurements are taken in the Northern Hemisphere (mainly in the North America and Western Europe coasts). In situ non-spectral and spectral buoys and ships provide the majority of these data with acceptable frequency and marginal accuracy. Limited number of *in situ* spectral buoys is available around the globe. Current *in situ* reports are not standardized resulting in impaired utility. Differences in measured waves from different platforms, sensors, processing and moorings are identified. In particular, a systematic 10% bias was identified between US and Canadian buoys, the two largest moored buoy networks. Standardized measurements and metadata are essential to ensure consistency between different platforms.

In situ measurements are currently too sparse in the open ocean due to poor coverage and are of no particular value, but could potentially provide higher accuracy observations to complement and correct the biases in the satellite observations. Validation requirement is for average 1000km spacing requiring a network of around 400 buoys with minimum 10% / 25cm accuracy for wave height and 1 second for wave period. Higher density (horizontal resolution of 500km) would be advantageous for data assimilation. In regions where known non-linear interactions between waves and local dynamic features exist (e.g., Agulhas Current, Gulf Stream, and Kuroshio Current) higher density (horizontal resolution of 100km) would be an advantageous.

The satellite altimeters provide information on significant wave height with global coverage and good accuracy, however, a horizontal / temporal coverage is marginal and a minimum 20km resolution is required for use in the regional wave models. Along track, spacing is likely to be adequate to meet this requirement; cross-track spacing is not. Multiple altimeters are therefore required to provide adequate cross-track sampling. Fast delivery (within 6 hours at most) is required with accuracy of 10% / 25cm for wave height, and 1 second for wave period. Long-term, stable time series of repeat observations are required for climate applications.

SAR instruments provide information on the 2-D frequency-direction spectral wave energy density with good accuracy but marginal horizontal / temporal resolution. Horizontal resolution of 100km is required for use in regional models, with fast delivery required (within 6 hours). Real aperture radar capability is expected to be available within 5 years.

Coastal wave models require different observing methods to those used for the open ocean due not only to their high-resolution, but also due to limitations of the satellite data close to land, hence for these models systems such as coastal HF radar are of particular importance. These radars provide information on significant wave height with limited coverage, good accuracy and acceptable horizontal/temporal resolution. High-resolution observations (up to 100m resolution) are required over coastal model areas.

Potential contribution from other technologies and platforms (e.g., navigation radar, other radars, and shipborne sensors such as WAVEX) should be developed where they can contribute to meeting the specified requirements.

2.2 Sea Level

Traditionally, permanent sea level stations around the world have been primarily devoted to tide and mean sea level applications, both non-requiring real or near-real time delivery. This has been the main objective of the Global Sea Level Observing System (GLOSS). Because of this focus, not only are wind-waves filtered out from the records by mechanical or mathematical procedures, but any oscillation between wind-waves and tides (e.g., seiches, tsunamis, storm surges, etc.) has not been considered a priority; in fact, these phenomena are not properly monitored (standard sampling time of more than 5 to 6 minutes). Due to the increased demand for tsunamis, storm surges and coastal flooding forecasting and warning systems, for assimilation of *in situ* sea level data into ocean circulation models, and for calibration / validation of the satellite altimeter and models, this range of the spectrum should be covered with immediate effect, and considered when choosing a new instrument and designing the *in situ* sea level station. Additionally, there has been an emphasis on making as many GLOSS gauges as possible to deliver data in real and / or near-real time, i.e., typically within the hour. An ongoing issue with these data is sea level measurements, which have not integrated well into NHMSs.

The aim of any tide gauge recording should be to operate a gauge, which is accurate to better than 1cm at all times; i.e., in all conditions of tide, waves, currents, weather, etc. This requires dedicated attention to gauge maintenance and data quality control. In brief, the major requirements for *in situ* sea level stations are:

- A sampling of sea level averaged over a period long enough to avoid aliasing from waves, at intervals of typically 6 or 15 minutes, or even 1 minute or less if the instrument is to be used also for tsunami, storm surges and coastal flooding forecasting and warning; but in all circumstances the minimum sampling interval should be one hour, which these days is an insufficient sampling for most applications – marginal accuracy,

- Gauge timing be compatible with level accuracy, which means a timing accuracy better than one minute (and in practice, to seconds or better, with electronic gauges) – marginal accuracy,

- Measurements must be made relative to a fixed and permanent local tide gauge benchmark (TGBM). This should be connected to a number of auxiliary marks to guard against its movement or destruction. Connections between the TGBM and the gauge zero should be made to an accuracy of a few millimetres at regular intervals (e.g., annually) – acceptable accuracy,

- GLOSS gauges to be used for studies of long term trends, ocean circulation and satellite altimeter calibration / validation need to be equipped with GPS receivers (and monitored possible by other geodetic techniques) located as close to the gauge as possible,

- The readings of individual sea levels should be made with a target accuracy of 10 mm – acceptable accuracy

- Gauge sites should, if possible, be equipped for recording tsunami and storm surge signals, implying that the site be equipped with a pressure sensor capable of 15-seconds or 1-minute sampling frequency, and possibly for recording wave conditions, implying 1-second sampling frequency – poor accuracy; and

- Gauge sites should be also equipped for automatic data transmission to data centres by means of satellite, Internet, etc., in addition to recording data locally on site.

Coastal sea level tide gauges are invaluable for refining tsunami warnings, but due to nearshore bathymetry, sheltering, and other localized conditions, they do not necessarily always provide a good estimate of the characteristics of a tsunami. Additionally, the first tide gauges to receive the brunt of a tsunami wave do so without advance verification that a tsunami is under way. In order to improve the capability for the early detection and real-time reporting of tsunamis in the open ocean, some countries have begun deployment of tsunameter buoys in the Pacific, Indian, and Atlantic Oceans and other tsunami-prone basins. Due to cost constrains, the number of DART buoys deployed and maintained is still limited – marginal geographic coverage and good accuracy.

The geographic coverage of the *in situ* sea level data is acceptable for studies of long-term trends, but marginal for other applications. Tsunami and storm surge-prone basins (e.g., Bay of Bengal, Gulf of Mexico and Pacific Islands) require higher density of sea level observations. Sea level measurements should be accompanied by observations of atmospheric pressure, and if possible, winds and other environmental parameters, which are of direct relevance to the sea level data analysis.

Satellite altimeters provide information on sea surface height with global coverage and good accuracy, i.e., within 1cm at a basin scale. However, horizontal / temporal coverage is marginal. The main limitation of the satellite altimeter in reproducing the non-long-term sea level changes is the spatial sampling because the repeat orbit cycle leads to an across-track spacing of about 300km at mid-latitudes. This sampling cannot resolve all spatial scales of mesoscale and coastal signals, which have typical wavelengths of less than 100km at mid-latitude. The scales are even shorter at high latitudes (around 50km), but fortunately the ground track separation decreases with latitude. Thus, to cover the whole mesoscale and coastal domain it is necessary to increase the spatial sampling by merging (in an optimal way with cross-calibration) different altimetry data sets. The temporal changes in sea level are usually determined along the repeat tracks of altimetry satellites. In areas close to the coasts (less than 20km), the difficulty is even larger because of the proximity of land which the track spacing is too coarse to resolve the short scales of the sea level changes. Thus, adaptive tracker and / or specific re-tracking of altimeter waveforms and near-shore geophysical corrections (such as coastal tide models and marine boundary layer tropospheric corrections) are needed.

2.3 Sea Surface Height Anomalies

An important corollary application to sea level and the associated instrumentation is sea surface height anomalies (SSHA). SSHA provides an estimate of the integrated distribution of mass within the ocean (the analogue of sea level pressure for the atmosphere). SSHA is the only remote sensing observations that provide information about the ocean below the mixed layer. Gradients in SSHA (or pressure) drive ocean circulation on spatial scales ranging from sub-mesoscale to Gyre scale and temporal scales of hours through decades.

High-resolution sea-surface height anomalies (SSHA) observations are required for: (i) ocean forecasting systems (assimilation in and validation of ocean models); and, (ii) marine services.

The table below specifies the consolidated user requirements for ocean forecasting systems and marine services.

	Spatial resolution (km)	Delivery timeliness (hours)		Accuracy (m)
		Target	Threshold	
Coastal Ocean	< 5	3	6	< 0.08
Open Ocean	5-10	6	24	< 0.08

SSHA has been observed through a series of narrow swath instruments since 1992 (Topex-Poseidon, Jason, Jason2, ERS, ERS-II, Envisat, Geosat, and GFO). Throughout this period, there have been periods of 1 through to 4 altimeters operating to conclusively show the benefits of the higher spatial and temporal coverage. It is now commonly accepted that a minimum of two interleaved operational satellites is required to support ocean forecasting applications. However, quantifiable benefits are obtained with additional satellites. These benefits predominantly are constrained to the regions of high mesoscale variability associated with all the major currents, Gulf Stream, Kuroshio Current, Agulhas Current, Brazil Current, Antarctic Circumpolar Current and East Australian Current and many other lesser but locally important current systems. Frequently, these regions are associated with high population density coastal regions, large active ports, biologically productive regions with important applications for search and rescue, coastal environmental management, fisheries management, defence and security and many others.

The timescale for scheduling satellite missions and the competition for the budget has impacted the continuity of altimetry over the past decade and into the future. Securing an operational observing system is critical to national service providers delivering reliable, quality ocean services required to attract the full spectrum of applications. Forecasting SST and surface currents for use by mature prediction systems such as NWP and wave forecasting will not be fully realised until ocean prediction systems achieve homogeneous skilful performance. The future progression toward fully coupled ocean-wave-NWP systems for short-range prediction will similarly require high reliability and quality from the ocean observing system. SSHA is currently considered the most critical component of this observing system for ocean prediction systems.

The orbit period of satellite altimeters is ~10 days for Jason1, Jason2, and ~ 35 days for Envisat. SSHA products are provided in three forms, OGDR (24 hrs behind real-time), IGDR (3 days behind real-time) and GDR (>7 days behind real-time). Only Jason2 provides an OGDR product. Many operational ocean prediction systems perform analyses up to 5-14 days behind real-time to include maximum coverage of altimetry. Substantial skill is lost at real-time by the integration of the ocean model between the analysis time and real-time. Multiple narrow-swath satellites or one wide-swath altimetry would permit an analysis closer to real-time enhancing forecast skill.

SSH is used in ocean models to provide adjustments to the sub-surface density structure of the ocean. It is critical that a global in situ profiling system be maintained to calibrate/validate these projections and further constrain the deep ocean through assimilation. The transition of part or all of the existing Argo system to permanent funding is critical to operational ocean prediction.

SSH, observations can also be exploited in the coastal regions; however, the spatial and temporal requirements in the coastal zone place greater constraints on the existing remote sensing observing system. Wider-swath observations would add significant value in this zone as well as the open ocean. Enhancing existing coastal tide gauges networks through real-time reporting will also add significant value to ocean prediction systems in the shelf zone.

2.4 Sea-Ice parameters (thickness, coverage / concentration, type / form, and movement)

Sea-ice charts containing information of sea-ice thickness, coverage / concentration, type / form and movement are produced in support of marine operations, validation of models and for climatological studies.

Although broad knowledge of the extent of sea-ice cover has been totally revolutionized by satellite imagery, observations from shore stations, ships and aircraft are still of great importance in establishing the “ground truth” of satellite observations. At present, observations of floating ice depend on instrumental and, to lesser extent, on visual observations. The instrumental observations are by conventional aircraft and coastal radar, visible and infra-red airborne and satellite imagery, and more recent techniques, such as passive microwave sensors, laser airborne profilometer, scatterometer, side-looking (airborne) radar (SLAR / SLR) or synthetic aperture radar (SAR, satellite or airborne).

Visual observations from coastal settlements, lighthouses and ships provide an ice report several times a day as the ice changes in response to wind and ocean currents, but the total area of ice being reported is very small (e.g., from a ship, observations can cover a radius of only 7–8 km; from a coastal lighthouse, observations can cover a radius of 20km). In some marine areas, such as the Baltic Sea, visual observations may be present in sufficient numbers that a reasonable proportion of the ice cover can be reported each day by a surface network. In others such as the Gulf of St Lawrence, where the waterways are broad and the shores often unsettled, no shore reporting system can provide data on more than a very small percentage of the total ice cover. Although surface based reports can provide excellent detail about the ice, especially its thickness, it is generally recognized that for most areas, the surface reports are not adequate to describe ice conditions fully.

Surface reports from shore stations, ships and drifting buoys provide accurate information on ice amount, thickness, movement and its deformation over rather small areas. When many vessels and fixed observing points are available, accurate information can be provided in restricted waterways. Many areas of the Kattegat and Baltic Sea coastline fall into this category.

Reports about the ice coverage taken from the air, i.e., helicopters and fixed-wing aircraft, have the advantage of a much better viewing angle; the platform’s flying speed allows a great deal more of the sea-ice to be reported; and problems of remoteness from airports or other suitable landing sites can be overcome by using long-range aircraft. In the various stages of development of sea-ice, estimates its amount; notes its deformation and the snow cover or stage of decay data are provided by visual estimation. Comprehensive aerial reporting has its own particular requirements beginning with an accurate navigational system when out of sight of land. Inclement weather – fog, precipitation and low cloud – will restrict or interrupt the observations and the usual problems of flying limits at the aircraft base may be a factor even if the weather over the ice is adequate for observing.

Recent advances in technology are now permitting more accurate data to be obtained by aerial observations. SLAR and SAR can provide information, which documents precisely the distribution and nature of the ice in one or two belts along the flight path of the aircraft for distances of up to 100km on each side. Unlike most other sensors, the radar has the capability of monitoring the ice under nearly all weather conditions.

When no fog or low clouds are present, a laser airborne profilometer can be used to measure the height and frequency of ridges on the ice, and under similar conditions, an infrared airborne scanning system can provide excellent information with regard to floe thickness in the ranges below 30cm.

The advent of earth-orbiting meteorological satellites has added a third, and now the most important and predominant mode of observing sea ice but again there are some restrictions. The spectral range of the sensors may be visible, infrared, passive or active microwave or a combination of these. Satellite coverage may be broad at low resolution or cover a narrow swathe at high-resolution. In the latter case, data from a particular location may be obtained only at temporal intervals of several days.

In general, most meteorological satellites provide 10–12 passes daily in the Polar Regions, i.e., complete coverage of Polar Regions once or twice a day. These satellites provide visible and infrared imagery with resolutions of 250m–1km; and passive microwave and scatterometer data at coarser resolutions of 6–70km – good horizontal / temporal coverage.

Visible and infrared data do not have cloud-penetrating capability while microwave data are practically cloud independent. Active microwave SAR data are characterized by improved ground resolution (approximately 10–100m) but a reduced coverage due to narrow swathes and greater re-visit time between exact repeat orbits. Snow cover on the ice and puddles on the floes are other complicating factors. Interpretation of SAR images may be even more difficult due to the ambiguities associated with SAR backscatter from sea-ice features that vary by season and geographic region.

Space-borne sensors can provide precise data on the location and type of ice boundary, concentration or concentration amounts (in tenths or percentages) and the presence or absence of leads, including their characteristics, if radar sensors are used. Less accurate information is provided on the stages of development of the sea ice including the FY / MY ratio, forms, with an indication of whether ice is land-fast or drifting, stages of ice melting and ice surface roughness. Flow motion over approximately 12–24-hour intervals can often be determined using imagery from sequential orbits.

2.5 Sea-Surface Temperature (SST)

High-resolution sea-surface temperature (SST) observations are required for: (i) NWP (addressed in the global and regional NWP SoGs), (ii) Seasonal to Inter-annual Forecast (addressed in the SIA SoG), (iii) ocean forecasting systems (assimilation in and validation of ocean models) and, (iv) marine services.

Coastal and inland seas users are defined as those using SST data products for regional ocean modelling and marine services. SST in the coastal and inland regions have a large variability due to the diurnal cycle of solar radiation, which enhances surface characteristics of the land and sea and forces land-air-sea interactions, i.e., land-sea breezes. Typically, this user group has a requirement for ultra-high resolution SST data sets (1km spatial resolution and <6 hours temporal resolution), with good accuracy (< 0.1 °C) and temporal coverage (hourly).

The table below specifies the consolidated user requirements for ocean forecasting systems and marine services.

	Spatial resolution (km)	Delivery timeliness (hours)		Accuracy (°C)
		Target	Threshold	
Coastal Ocean	< 1	1	3	< 0.1
Open Ocean	5-10	1	6	< 0.1

Ships and moored and drifting buoys provide observations of sea-surface temperature of good temporal frequency and acceptable accuracy as long as required metadata (e.g., the depth of the measurement is essential for deriving the diurnal cycle and the foundation temperature) are provided. Coverage is marginal or worse over some areas of the ocean globe. There is a requirement for high quality SST in open ocean, ideally with accuracy < 0.1 °C on 5km spatial scale, and fast delivery (availability within 1h). In coastal regions, higher density is required (accuracy < 0.1 °C on 1km spatial scale).

Drifting Buoy and other *in situ* SST measurements are used for calibration / validation of satellite data, in the error estimation for observations products and in the combined analysis products. They are critically important providing bias correction of these data. Satellite biases can occur from orbit changes, satellite instrument changes and changes in physical assumptions on the physics of the atmosphere (e.g., through the addition of volcanic aerosols). Thus, drifting buoy and other *in situ* data are needed to correct any of these changes.

Satellite measurements provide high-resolution sea surface temperature data. Both the infrared and the microwave satellite data are important. Microwave sea-surface temperature data have a significant coverage advantage over infrared sea-surface temperature data, because microwave data can be retrieved in cloud-covered regions while infrared cannot. However, microwave sea-surface temperatures are at a much lower spatial resolution than infrared. In addition, microwave sea-surface temperatures cannot be obtained within roughly 50km of land. A combination of both infrared and microwave data are needed because they have different coverage and error properties.

Instruments on polar satellites provide information with global coverage in principle, good horizontal and temporal resolution and acceptable accuracies (once they are bias-corrected using *in situ* data), except in areas that are persistently under cloud (which includes significant areas of the tropics). High-resolution SSTs (1 km) can be retrieved by the LEO infrared radiometer and rather degraded resolution SSTs (5 km) from the GEO IR radiometer. However, quantitative detection of the SST diurnal cycle is still challenging subject but drifters can provide high temporal resolution SST data. In contrast, microwave radiometers cannot be used for the coastal applications because of: (a) rather coarse spatial resolution; and, (b) contamination of land signals in the measurement in the coastal sea.

2.6 Sea-Surface Salinity (SSS)

High-resolution and high quality sea-surface salinity (SSS) observations are required for ocean forecasting systems (assimilation in and validation of ocean models). Applications for Sea-surface Salinity are expected to also include Seasonal to Inter-annual forecasting and NWP (distribution and quantity of precipitation).

Frequent sea-surface salinity sampling with global coverage and sufficient accuracy will provide a constraint on the temporal and spatial distribution of precipitation. The remote sensing instrumentation remains experimental and the full impact of these observations are yet to be determined. None the less, there is a requirement to constrain this state variable at the surface where the variability is greatest and the mass fluxes are known to have large errors.

Coastal and inland seas users are defined (as per SST above) as those using SSS data products for regional ocean modelling and marine services. SSS in the coastal and inland regions have a larger variability due to coastal systems (e.g., upwelling/downwelling processes) and river discharge as well as enhanced evaporation in regions shallower than the optical depth or weak circulation. Typically, this user group has a requirement for higher resolution SSS data sets (1km-5km spatial resolution and <6 hours temporal resolution), with good accuracy (< 0.1-0.7 psu) and temporal coverage (hourly). The spatial scales of variability in the open ocean are dominated by the mesoscale with a resolution of 10-25km and temporal resolution of 12-25 hours. The accuracy range represents thresholds of accuracy that will impact an analysis and depend on the region of the ocean being observed.

The table below specifies the user requirements for ocean forecasting systems and marine services.

	Spatial resolution (km)	Delivery timeliness (hours)		Accuracy (psu)
		Target	Threshold	
Coastal Ocean	< 1 -5	3	6	< 0.1-0.7
Open Ocean	10-25	12	24	< 0.1-0.7

Ships, moored and other in situ observations of sea-surface salinity of good temporal frequency and acceptable accuracy as long as required metadata (e.g., the depth of the measurement is important for deriving the freshwater lens effects) are provided. Coverage is marginal or worse over some areas of the ocean globe. There is a requirement for high quality SSS in open ocean, ideally with accuracy < 0.1-0.7 psu on 10km spatial scale, and fast delivery (availability within 1h). In coastal regions, higher density is required (accuracy < 0.1 psu on 1km spatial scale).

2.7 Sub-surface Temperature, Salinity and Density

Sub-surface temperature, salinity and density observations are required for: (i) Seasonal to Inter-annual Forecast (SIA) (addressed in the SIA SoG); (ii) for assimilation and validation of ocean models; and, (iii) marine services.

The Tropical Atmosphere Ocean (TAO) / TRITON moored buoy network provides data with good frequency and accuracy, and acceptable spatial resolution for the tropical Pacific. The TAO Tropical Moored Buoy Arrays provide data of marginal vertical resolution for marine services applications (~50m down to 500m), which require high vertical resolution data in the mixed layer. The tropical moored network in the Atlantic (PIRATA) is acceptable. The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) is being developed but is providing only marginal sampling at present. Sustained funding for the Tropical Moored Buoy Arrays remains a matter of concern.

Ships (XBT profiles) provide temperature profile data of acceptable spatial resolution over many of the targeted frequently repeated and high [horizontal resolution] density lines. However, approximately half the targeted lines are still poorly sampled. Temporal resolution is marginal, and acceptable in some ship specific lines. XBTs provide data with good vertical resolution (typically 1m) down to 1000m depth in delayed mode, but real-time data are constrained to limitation in the GTS traditional character codes being used at present.

The *Argo* profiling floats provide global coverage of temperature and salinity profiles to ~2000 m, mostly with acceptable-to-good vertical (every ~5m) and spatial resolutions, but only marginal temporal resolution, particularly for marine services. The accuracy is acceptable for assimilation in ocean models and for marine services. The existing sampling is adequate for ocean prediction in regions of low spatial and temporal variability. However, regions of more active geostrophic turbulence would be enhanced through higher spatial/temporal sampling. An autonomous based system will typically spend less of its lifetime in such regions and therefore adequate sampling presents a challenge. In order to achieve the required sampling for ocean prediction applications, target deployment into these regions, together with the modified cycling patterns.

2.8 Ocean Colour

Ocean colour observations are required for marine services applications and for validation of ocean models. The ocean colour remote sensing provides images of biological / non-biological parameters with high-spatial resolution (250m to 1km), and is able to detect several types of marine pollutions, harmful algae and red tide plankton blooms. Parameter retrieval algorithm in turbid waters is not established yet, but developments of an observation system based on the Ocean Colour remote sensing have presented promising results for a future operational observing system. *In situ* measurements are needed to complement satellite ocean colour observations. These measurements should be accompanied by real-time daily observations of ocean temperature, surface wind and derived dynamic height.

2.9 3-D Ocean Currents

Observations of 3-D ocean currents are required for marine services applications, and for testing and validation of ocean models.

Inferred surface currents from drifting buoys are acceptable in terms of spatial coverage and accuracy and marginal temporal resolution. Targeting deployments of drifting buoys into regions of high variability such as boundary currents and downstream geostrophic turbulence would help enhance its impact to ocean prediction systems. Moored buoys are good in temporal resolution and accuracy, but marginal or worse otherwise. The Acoustic Doppler Current Profiler (ADCP) provides observations of ocean currents over a range of depths, with acceptable accuracy. Coverage is marginal or worse over some areas of the ocean globe, and marginal vertical resolution for marine services applications, which require high vertical resolution data in the mixed layer.

Satellite altimetry is being used to infer the distribution of ocean currents (geostrophic velocity). Satellite altimetry provides more homogeneous space and time coverage than *in situ* observations, but they cannot determine mean currents. Velocities derived from Lagrangian drifters are acceptable in terms of accuracy (2 cm / s) and spatial coverage (5° lat. / lon.), however their marginal temporal resolution is typically 1 month. Satellite altimetry permits to derive the ageostrophic motion (e.g., centrifugal, Ekman, ageostrophic submesoscale) and the time-mean motion. Satellite altimetry permits to detect geostrophic eddies. Global mean dynamic topography can be obtained by combining information on the geoids, altimeters, drifters, wind field, and hydrography. These products are poor in terms of timeliness required for marine services applications. HF Radars provide for good temporal and spatial resolution in coastal regions, and marginal accuracy.

2.10 Bathymetry, Coastal Topography and Shorelines

Observations of bathymetry, coastal topography and shorelines are required for ocean and coastal modelling. Very high-resolution data are required due to the gradual changes of the coastline through erosion and accretion processes relating to coastal meteorological and oceanographic phenomena (e.g., waves, storm surges and sea ice). Visible and infrared imagers (i.e., Landsat, Spot), synthetic aperture radar (SAR) and aerial photography provide good information on the coastline and coastal topography.

Many sonar techniques have been developed for bathymetry. Satellite altimeters map deep-sea topography by detecting the subtle variations in sea level caused by the gravitational pull of undersea mountains, ridges, and other masses. These provide global coverage and acceptable-to-good accuracy.

2.11 Surface Wind over the Ocean and Coastal Areas (10m)

High-resolution surface wind over the ocean and coastal areas is required as an input field for ocean models (including wave models), and for marine services. The surface wind is a key variable for driving ocean models and to nowcast and forecast marine meteorological and oceanographic conditions. It is strongly influenced by the coastal topography and land-sea surface conditions. Traditional global and regional NWP products do not have enough spatial resolution for marine services applications, as well as for coastal modelling.

Voluntary Observing Ships (VOS) and meteorological and oceanographic moored buoys provide observations of acceptable frequency. Accuracy is acceptable. Coverage is marginal or worse over large areas of the ocean globe. The tropical moored buoy network has been a key contributor for surface winds over the last decade, particularly for monitoring and verification, providing both good coverage and accuracy in the equatorial Pacific. Fixed and drifting buoys and VOS outside the tropical Pacific provide observations of marginal coverage and frequency; accuracy is acceptable. Wind observations from drifting buoys are poor.

Polar satellites provide information on surface wind, with global coverage, good horizontal resolution, and acceptable temporal resolution and accuracy. The microwave scatterometer has limited spatial resolution (25km), and the wide swath SAR measurement has limited temporal resolution (one measurement every few days) and provides no wind direction.

2.11 Surface pressure

Ships and buoys take standard surface observations of several atmospheric variables, including surface pressure. In relatively shallow waters, oil platforms do the same, but the frequency and spatial coverage are marginal for marine services applications. Mean sea level pressure is vital to detect and monitor atmospheric phenomena over the oceans (e.g., tropical cyclones) that significantly constrain shipping. As stated in the SoG for Synoptic Meteorology, even very isolated stations may play an important role in synoptic forecasting, especially when they point out differences with NWP model outputs.

2.12 Surface heat flux over the ocean

High-resolution surface heat flux over the ocean is required as input fields to ocean models and for marine services. Surface heat flux is of critical importance to improve the skill of forecasts of sea surface temperature and entrainment of heat into the surface mixed layer. Improved performance will have impacts on NWP forecasts, sonar prediction as well as reduce background errors in ocean data assimilation. Total heat flux is composed of downward shortwave, net longwave, latent heat flux and sensible heat flux. Accuracy strongly depends on both the cloud physics parameterisations, radiation physical parameterisations and adequate atmospheric observing systems. NWP products are reliable and provide adequate products for current applications.

High quality marine met stations are required to more, accurately observe the fluxes over the ocean to enhance the physical parameterisations contained in the NWP products. Deployment of met stations in mid- and high-latitudes will further enhance this development over the range of conditions that occur at the air-sea interface.

2.13 Visibility

Poor visibility is a major hazard to all vessels because of the increased danger of collision. Surface visibility observations are made primarily by ships, and at the coastal stations (mainly at harbours, where the VTS (Vessel Track System is usually available)). This parameter can vary substantially over short distances. Accuracy is acceptable in coastal areas and marginal in open ocean. Horizontal / temporal resolution is poor over the most of the global ocean. Satellite and radar data are the only means for providing information on visibility, including fog, in the open-ocean and near-shore, respectively. Typically, visibility is deduced from the output of regional atmospheric models (see regional NWP SoG).

2.14 Summary of the Statement of Guidance for Ocean Applications

The following key points summarize the SoG for Ocean Applications:

- Satellite data are the only means for providing high-resolution data in key ocean areas where *in situ* observations are sparse or absent;

- In general, *in situ* met-ocean data and observations are insufficient for marine services (in particular, for monitor and warning marine-related hazards) and marginal for assimilation in ocean models, including wave models;

- Better integration of met-ocean measurements into NHMSs and their sustainability are needed; and,

- In general, there is a requirement for fast delivery of met-ocean data.

The critical met-ocean variables that are not adequately measured (more accurate and frequent measures and better spatial/temporal resolution are required) by current or planned systems are:

- Waves parameters (significant wave height, dominant wave direction, wave period, 1-D and 2-D spectra) – noting that extreme wave and wind gusts events significantly constrain shipping and other marine operations. The collocation of wind and wave sensors is recommended,

- Sea level – noting the wide-range of requirements for sea level data depending on the application area (since early detection of e.g., tsunamis to long-term trends of sea level rise), the requirements for this variable into the database should be carefully addressed,

- Surface pressure – noting that sea-surface pressure data from drifting and moored buoys are still limited, particularly in tropical regions where these data are vital to detect and monitor atmospheric phenomena over the oceans (e.g., tropical cyclones) that significantly constrain shipping, it is recommended the installation of barometers on all deployed drifters (1250), and

- Visibility – noting that visibility data are critical for harbours' operations and as these are still very limited, the NMHSs are encouraged to measure visibility.

APPENDIX D

MAJOR OUTCOMES OF THE SEVENTH SESSION OF THE JCOMM MANAGEMENT COMMITTEE
(Melbourne, Australia, 8-12 December 2008)

Management issues

1.1 The Management Committee (MAN) decided to establish three task teams to address priority areas within both WMO and IOC: (1) Task Team on Quality Management Framework (led by Dr Philippe Dandin); (2) Task Team on Coastal Inundation (led by Dr Regina Folorunsho); and (3) Task Team on Methods for Transmission of Graphical Products to Marine Users (led by Mr Robert Keeley). Roadmaps for developing these activities should be prepared by 31 May 2009.

1.2 The Committee reviewed the WMO Madrid Action Plan (MAP) and agreed that there was no need to undertake any specific action, apart from compiling what has been done or is being done with respect to socio-economic benefits.

1.3 The Committee requested the outgoing co-presidents and PA coordinators at JCOMM-III to prepare personal assessments of what was successful and what was not, ("lessons learnt from experience") and provide them to the incoming officers at JCOMM-III.

1.5 In response to the requirements of WMO and IOC for reporting the implementation plans of their major subsidiary bodies against the expected results under the respective Organizational strategies, the Committee endorsed the proposed alignment of the JCOMM Operating Plan with the WMO and IOC Strategic Planning in terms of deliverables and/or achievements planned for presentation to JCOMM-III. The Committee agreed that it was necessary to complete the process of preparing the Implementation, Operating and Management Plans, with a view to presenting these documents in an accessible form to JCOMM-III. Additionally, the Committee recognized the urgent need to revise and update the JCOMM Strategy document, for presentation to JCOMM-III. Finally, the Committee requested the Secretariat to prepare and issue a new JCOMM Newsletter during the first quarter of 2009.

OPA-related activities, including satellite observing systems

1.6 The Committee reviewed the draft table of OPA deliverables/achievements as well as the OPA work plan, and recommended future reporting of ECV-based (Essential Climate Variables) metrics and indices for satellite and in situ data and metadata. A new Expert Team on Satellite Data Requirements (ET-SAT) was agreed that would focus on the coordination of ocean variables where a viable integrating participation group was available. A TT will be established for each variable with a member from each PA and from the integrating participation group.

1.7 The Committee noted the evaluation process for the WMO-IOC Observing Programme Support Centre (OPSC). Regarding the membership of the 'Letters of Intent (LoIs) for hosting an OPSC' review committee, the Committee recommended inviting external member(s) in order to obtain objective external opinion, and requested the Joint Secretariat to seek suitable person(s) to invite for the membership. The Committee noted that several items in the technical and administrative questionnaires needed further clarification (e.g. procedures for IS network security, 24/7 monitoring system for the OPSC Information System components), and requested the evaluation committee to consider them when evaluating short-listed institutions. The Committee noted that, considering the increasing requirements from the user community, the future OPSC would need to consider enhancing links with the satellite information services, and suggested drafting/updating the ToR of a future OPSC in this regard (by JCOMM-III).

1.8 The Committee recalled that, at its last session, the Satellite Rapporteur was charged with drafting a document entitled: “Observing the Global Ocean for JCOMM - The Integrated Space-based and *in situ* Strategy.” The Committee agreed that this document would cover the current use of space and in situ observations in existing products and services, including tables of current requirements by variable. The Committee agreed on a timetable leading to the completion for JCOMM-III.

DMPA-related activities

1.9 The Committee reviewed and agreed on the DMPA document on deliverables and/or achievements planned for presentation to JCOMM-III, together with the work plans. The Committee noted that the DMPA project proposed to WIGOS was accepted by WMO. This was combined with an activity started in IODE, the Ocean Data Portal, to present a composite project that is underway. It recommended that a demonstration of the Ocean Data Portal would be convened at JCOMM-III. The Committee agreed that “Data and Information Exchange Cookbook” for oceanographers and marine meteorologists would be a valuable contribution to upgrading the documentation of best practices.

1.10 The Committee stressed that the identification of potential DCPCs at this time was not possible because the obligations for operating a DCPC are not sufficiently clear. In particular, it will be important to have a checklist of the requirements that need to be met by potential DCPCs such as details of the commitments to service provision, and how candidate agencies can demonstrate their ability to meet the requirements. In addition, the compatibility of the DCPC software with national IT security constraint needs to be determined. As DCPCs begin to provide a wide variety of data, particularly from the ocean, the issue of version control of the data will become increasingly important. It is hoped and recommended that the NMHSs and national oceanographic institutions take this as an opportunity for enhancing their collaboration.

SPA-related activities

1.11 The Committee reviewed and agreed on the SPA document, on deliverables and/or achievements planned for presentation to JCOMM-III, together with the work plans. The Committee noted that SPA activities initiated at MAN-VI had largely been fulfilled in spite of the lack of resources; however, many activities have had trouble to conclude.

1.12 The Committee endorsed that ET-OOFS would ensure that mature GODAE activities were continued and coordinated and would provide a means to integrate the activities of JCOMM in terms of quality control of observations (through data pre-processing and data assimilation) and for data management in terms of standardization of data products. Recognizing the need for a definition of Nomenclature, Standards and Symbology for ocean forecast systems and that the creation of such a document would be a large task, the Committee requested the Secretariat to seek for extra-budgetary funds to undertake a 6-month contract activity.

1.13 The Committee agreed that a coordinated effort between Bilko and JCOMM would be valuable to develop capacity in the application of ocean forecast data sets, and requested Dr Donlon and the Secretariats to set up a plan for training opportunities in close coordination with the IOC Project Office for IODE in Ostend, Belgium.

1.14 The SPA International Met-ocean Safety Conference (IMSC) was discussed noting that despite several meetings to scope the conference; no conclusion had been reached in terms of initiating the conference. Following discussions, the Committee agreed that, given the limited resources currently available and limited time prior to JCOMM-III, a session linking JCOMM activities and ocean observations at the OceanObs’09 conference would be an optimal way forward.

Capacity Building

1.15 The Committee agreed that a supplementary capacity building strategy for JCOMM was not required, a statement of principles for JCOMM Capacity Building would better represent the JCOMM requirements on CB and describe the implementation mechanism, and activities to be undertaken by JCOMM in this area, including training, transfer of technology, and development of projects. It reviewed and endorsed a set of CB principles, as follow: (note that there is no priority implied by the order of these principles)

(i) The primary objective of JCOMM Capacity Building is to enhance the implementation of the overall JCOMM Programme through enhancing capacity in all JCOMM Members/Member States to contribute to and benefit from the programme.

(ii) JCOMM capacity building activities should be the responsibility of the respective Programme Areas and included in their work plans.

(iii) JCOMM Capacity Building activities should aim to fill-in gaps and avoid overlapping at national, regional and international levels. It is highly desirable that national partners from both JCOMM themes (i.e., oceanography and marine meteorology) be involved so the complementary and "symbiotic" benefits of JCOMM are clearly demonstrated.

(iv) JOMMM Capacity Building will include continuous professional development.

(v) JCOMM Capacity Building will aim, where possible, for a "train the trainer" approach to help ensure continuity by countering staff turnover/brain drain problems and to promote the wide spread of knowledge and practices.

(vi) At the regional level, JCOMM Capacity Building will develop programmes and projects that follow WMO and IOC strategies (e.g. the ODIN strategy, developed by IOC/IODE).

(vii) At the regional level, JCOMM Capacity Building will develop, preferably, medium to long-term programmes and projects that will result in national structural and embedded capacity that can be sustained by national funding sources.

(viii) Creating awareness in the minds of the public and policy makers is essential for raising national and international support.

(ix) JCOMM Capacity Building activities will include assessment of feedback regarding the satisfaction and requirements of users of JCOMM observations, products and services.

(x) One member of the JCOMM Management Committee will be responsible for liaison with the three Programme Areas regarding Capacity Building activities.

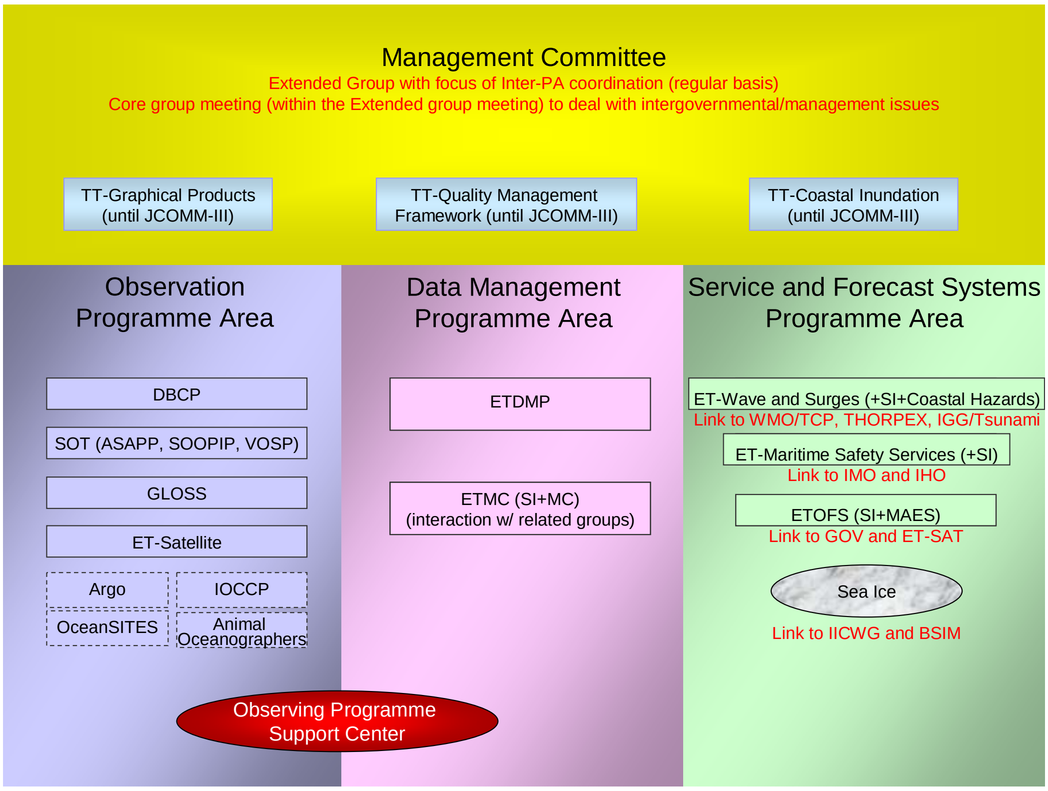
(xi) JCOMM Capacity Building activities should endeavour to utilize existing methods, courses, tools and other capacity building aids, particularly those of the WMO and UNESCO/IOC.

1.16 The Committee agreed that JCOMM capacity building activities should be the responsibility of the respective Programme Areas, being coordinated by a member of the Committee. It requested the PA coordinators to each nominate an expert to coordinate CB activities within their PAs.

Subsidiary structure for JCOMM

1.17 The Committee agreed that the new Management Committee should comprise of no more than 10 regular members. Recognizing the importance of inter-PA coordination in implementing the work plan of the commission, the Committee agreed that the future MAN should put more emphasis on communication and cross-collaboration among PAs. In this context, it was agreed that the future MAN meetings would focus on coordinating activities among PAs in response to crosscutting requirements.

1.18 Based on discussions and advice from the PA coordinators, the Committee reviewed the subsidiary structure and, in the light of its achievements, agreed on the broad structure presented in the following diagram:



JCOMM-III session

1.19 The Committee was informed that the third session of JCOMM (JCOMM-III) is scheduled to take place in Marrakech, Morocco, 4-11 November 2009. The Committee reviewed, revised and adopted the Provisional Agenda for JCOMM-III. The Committee agreed that the structure of the session would include "information sessions" on PAs activities, scientific and operational requirements, and integrated in situ and satellite observing systems. The Committee decided that the theme for the Scientific Lecture would be *Socio-economic benefits of Met-Ocean information and services*. The Committee agreed with the ETSI proposal that an Outstanding Service Certificate should be awarded to Mr John Falkingham (Canada) at JCOMM-III. The Committee also agreed that progress/activity reports for JCOMM-III be treated as an information document (INFO), which will be provided in two languages (English and French).

1.20 The Committee agreed on the following principles in recommending and selecting the Officers: (1) ensure that the expertise of candidates would be appropriate to the implementation of the work plans of JCOMM and its teams/groups; (2) consider the related regulations of WMO and IOC; and (3) make due consideration on geographical and gender balance. The PA coordinators and the co-presidents were asked to prepare draft ToRs and memberships of Expert Teams and Groups.

2. ACTIONS FOR THE SPA ARISING FROM THE SEVENTH SESSION OF THE JCOMM MANAGEMENT COMMITTEE

2.1 Annex I contain action items arising from the seventh session of the JCOMM Management Committee (Melbourne, Australia, December 2008). The status of the various actions was noted as appropriate.

ANNEX I

LIST OF ACTIONS FROM MAN-VII

Para	Action	By whom	When/ target	Status
3.1	To develop roadmaps for developing activities related to Quality Management Framework, coastal inundation, and methods for Transmission of Graphical Products to Marine Users	Task team leaders	31 May 2009	Ongoing
3.1 a)	To make available existing documentation on Quality Management Framework, including those documents developed for aeronautic meteorology	Secretariats	Done	Done
3.2	To prepare an inventory of socio-economic benefits' studies, in coordination with Dr Ralph Rayner, and present it to MAN	Ms Candyce Clark	ASAP	Ongoing
3.5	To prepare assessments of what was successful and what was not ("lessons learn from experience") and provide them to the incoming officers at JCOMM-III	Co-presidents and PA coordinators	JCOMM-III	Ongoing
4.1.2	To contact Dr James Baker to obtain the most recent drafts of the documents begun at MAN-VI	Co-presidents	Done	Done
4.1.2	To complete the Operating Plan	Dr Worth Nowlin	mid-January 2009	Ongoing
4.1.3	To arrange for the preparation of this new JCOMM strategy document	Co-presidents and Secretariats	ASAP	Ongoing
4.1.4	To prepare and issue a new JCOMM Newsletter	Secretariats and co-presidents	31 January 2009	Ongoing. To be issued by end April 2009
4.2.17	To seek funding, for the hire of a consultant to develop the Guide on Nomenclature, Standards and Symbology for ocean forecast systems	Secretariats	ASAP	Ongoing
4.1.18	To set up a plan for training opportunities in close coordination with IOC Project Office for IODE in Ostend, Belgium	SPA coordinator and Secretariats	ASAP	Ongoing
4.3.3	To complete the document entitled: "Observing the Global Ocean for JCOMM - The Integrated Space-based and *in situ* Strategy"	Dr Eric Lindstrom	prior to JCOMM-III	Ongoing
4.3.4	To review and complete the preparation of the full document on the CB principles	Dr Worth Nowlin	Done	Done
4.3.5	To each PA coordinator nominate an expert to coordinate CB activities within their PAs	PA coordinators	JCOMM-III	Ongoing

Para	Action	By whom	When/ target	Status
4.4.4	To participate in the Argo International Steering Team meeting	JCOMM co-president and the OPA coordinator	March 2009	P. Dexter and C. Clark will participate
5.4.1	To provide all documentation available on the status of the studies on methods of transmission of graphical products to mariners, being undertaken by JCOMM Teams to the DMPA coordinator	Secretariats	Done	Done
5.5.1	To identify potential JCOMM contributions to the development and establishment of the Storm Surge Watch Scheme	RA V Action Team	Done	Done
5.7.6	To take into account that these are several items in the technical and administrative questionnaires needed further clarification in evaluating short-listed institutions	OPSC Evaluation Committee	during the evaluation process	Ongoing
7.1.1	To finalize the explanatory memorandum and documentation plan	Secretariats	mid-January 2009	Done
7.2.2	To finalize arrangements for the Scientific Lecture to be convened at JCOMM-III	Co-presidents and Secretariats	ASAP	Ongoing
7.2.2	To identify possible candidates with a view to making a final decision during a teleconference with Committee members	Committee members	end of May 2009	Ongoing
7.3.3	To keep the PA coordinators and other experts submitting documents for the session informed of any changes in the number of words for each document;	Secretariats	Continuing from now to end of May 2009	Ongoing
7.3.4	To finalize the timetable for JCOMM-III	Secretariats	mid-January 2009	Done
8.2	To finalize the programme for the Technical Conference	Co-presidents and Secretariats	end of May 2009	TC was cancelled
9.1.2	To informally contact the recommended experts to become JCOMM Officers in order to ascertain their willingness and possibilities of their national support	Co-presidents and Secretariats	January 2009	Ongoing
9.2.1	To draft new ToRs for the future Groups and Teams	Co-Presidents and PA Coordinators	mid-January 2009	MAN, OPA and DMPA done. SPA – to be done at the SCG-IV

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